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Some models are terribly dumb

"WE WERE talking about his beard when he stepped into the room. I'm afraid he overheard us. Anyway an awkward silence followed." This, briefly, was the story told us by a young woman a few days ago. The yarn intrigued us, so we decided to re-enact the scene before the camera and present it to our audience. But it was a really harrowing experience. Just try and get a good photograph of an embarrassed silence! So we decided to show you the picture in the making—and here it is. It rather amuses us now—although we certainly went through agonies trying to get the photograph as originally planned.

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ENGLAND SENDS HER PRAISES TO AMERICA

Britisher Calls American Firm "Benefactors to Human Race"

The Englishman is everywhere acknowledged to be a keen judge of fine tobacco. Little wonder, then, that the makers of Edgeworth Smoking Tobacco, right down in our own Richmond, Virginia, are proud of this tribute to their product from Mr. W. J. Russell of Newton College, Devon, England.

Newton College
Newton Abbot
Devon, England
Nov. 20, 1931

Larus & Brother Company
Richmond, Virginia, U. S. A.

Gentlemen:

I have just purchased and begun to smoke some of your Edgeworth Plug Slice. How long it has been possible to obtain this delectable tobacco in this country I do not know, but I am so delighted at having discovered it that I want to record my appreciation of it and of the firm that produces it. I had not realized that a tobacco so superior to any other was obtainable. The discovery has pleased me so much that I am constrained to write to you, whom I regard as benefactors to all pipe-smoking members of the human race.

Please accept, gentlemen, my sincerest thanks.

Yours faithfully,
W. J. Russell

Edgeworth has found its way into most of the countries of the world. It is nearer the truth to say that pipe smokers of foreign nations have "discovered" Edgeworth. To literally millions of men Edgeworth has been the happy ending to the quest for smoking satisfaction. If you are not contented with your tobacco, try Edgeworth.

In his letter, Mr. Russell states that he, like many experienced pipe smokers who prefer to "rub up" their own tobacco, smokes Edgeworth Plug Slice. This is the form in which Edgeworth originally appeared, but it is also available as Edgeworth Ready-Rubbed, all ready for your pipe. Both Edgeworth Ready-Rubbed and Edgeworth Plug Slice come in all sizes from the 15-cent pocket package to the pound humidor tin.

If you have never smoked a pipe, and would like to know its joys and to "understand" the Edgeworth flavor, send your name and address to Larus & Brother Co., 110 S. 22d St., Richmond, Va., and they will send you a free trial packet of Edgeworth.

Every Thursday evening a group of Edgeworth men workers gather at the factory in Richmond to sing spirituals. See your local newspaper for time and nearest station. Program is listed as "Dixie Spiritual Singers."

Uncle Sam's New Plan *to* Make Money *for Hoarders*

By LEON MEADOW, *Financial Editor*

"HOW much do I owe you?" asked Paul Fielding, drawing out his wallet.

The service station owner scratched the side of his head. "Let me see, now . . . there's one flat, one new tube, two new valves . . . five gallons of special . . . that's $4.50 altogether."

Fielding gave him a ten-dollar bill, and the man—to make change—dug into his grimy overalls. He pulled out a large wad of bills, mostly "fives" and "tens." Handing the change to Fielding, he noticed the somewhat surprised look on the latter's face. "Safest place for my dough . . . can't trust anybody these days," he said with an apologetic smile.

As he put the car in first gear and drove out of the service station, Fielding said to his friend, Warren Sloan, sitting next to him, "I suppose that fellow thinks he's smart hoarding his money like that."

"I don't know whether he's smart or not," answered Sloan, "but he certainly isn't patriotic."

"Patriotism!" cried Paul angrily. "If the people who hoard their money these days would think logically about their own interests, the patriotic angle would take care of itself."

"What do you mean?" asked Warren.

His friend was silent for a few minutes, and seemed to be centering his attention on threading his way through the heavy rush-hour traffic. Soon, the city proper was left behind and they were on the open road, headed for the suburban town where both men lived next door to each other. "All this publicity in the papers recently about hoarding money," he said finally, "has set me thinking about this question. And the more I think of it, the more insane people's attitudes seem to me.

"Currency hoarding amounts to carrying more cash than we need for daily requirements. Whether it's carried on our persons, placed in a vault, under the bed, or in an old sock, it is still *hoarding*—and nothing else.

"Fear is at the back of it. Those that hoard do so because they are afraid of losing all or a part of their money, if they do not keep it in their immediate possession. By depositing it in banks, they figure to stand a loss by reason of bank failures. They shy away from purchasing real estate or securities, fearing decline in value. And when prices go down, they reason that their store of money, safely tucked away, will increase in value. Or, if they think they are exceedingly shrewd and believe that the Government will go off the gold standard, then they think that their hoardings will not depreciate in purchasing power because they have a hidden nest-egg of gold coins or dollar bills, calling for a certain equivalent in gold. Behind it all is fear . . . fear of losing."

"But this is nothing new, Paul," broke in Sloan. "There have always been, and always will be, hoarders. I mean, even in normal times you read every now and then in the papers stories of hoarders who died, leaving behind smaller or larger amounts of hidden money. Or else you read about hidden savings that have been lost, burned or stolen."

"Yes, of course you do," answered Fielding impatiently, "but the difference—and it's a big one—is that now we have a tremendous army of these hoarders, whereas in normal times you never hear of more than a few isolated cases, whose affairs aren't calculated to do much injury to anyone. Today, however, the hoarder is in much larger company, and though still the same frightened unreasoning person as of old, he can and is doing a lot of harm both to himself and to others. Essentially speaking, however, they are all the same insofar as they are all guided by one impulse—*fear*. And fear, as you know, is hardly ever at the bottom of wisdom.

"I'M NOT being unreasonable, as you can judge for yourself, Warren. I understand quite well that certain happenings, which have taken place around us during the last two years have caused many people to be justly skeptical about bank deposits and various sorts of investments—particularly people in the country where an unusually large number of banks have had to close their doors. And then, too, losses in bonds, in stocks, and in real estate have been appalling. As a result, the confidence of many otherwise intelligent people has suffered a severe shock. So I don't stand ready to join the ranks of those who at once condemn all hoarders as unpatriotic, selfish and so forth. It is only natural for a person—and he need not be ashamed of it either—to be concerned in these very trying times with the preservation of his savings, and to be willing to go to any lengths to safeguard it. This is a perfectly human instinct, and far be it from me to criticise. But, what does drive me wild is the faulty reasoning behind this currency hoarding, which, after all, can hardly be called an intelligent, nor even wise, method of self-protection.

(Continued on page 5)

UNCLE SAM'S NEW PLAN TO MAKE MONEY FOR HOARDERS

(Continued from page 4)

"For certain reasons, which he believes are sound, a man may withdraw his money from a bank or liquidate his securities. Assume for the sake of argument that his reasons are correct and it necessarily follows that he was right in what he did. You can't doubt his patriotism—for it certainly would be a poor country whose average citizen would be willing to keep his money invested in what he knew was unsafe!

"ON THE other hand, it can never be correct or wise, even from a purely selfish point of view, to hoard that money, to keep it idle, and often in places which are far from safe against loss by fire, theft, or other means. If this man is so worried about the safety of his money in banks or corporation securities, let him invest it safely and profitably in United States Postal Savings, guaranteed by this country's entire credit, where at least he would draw 2% interest for his trouble. Or let him buy Government Bonds, from $50 upward, or Liberty Bonds, or Treasury Bonds—all yielding anywhere from 2% to 4¼%, depending on which he selects. Then he ceases to be a hoarder and becomes a wise and conservative investor whose money is by far safer than it would be behind the stove or out in the back yard under the tomato patch. Particularly in these days of reduced incomes, poor business and unsafe jobs, he should be careful about not foregoing any added income that he might get."

"That's all good, sound common sense," put in Warren Sloan, "and, I should think, fairly obvious. Why is it, then, that hoarders don't follow this wiser and safer plan? Is it because they're totally ignorant of these safe means of investment—or, is it because they don't even trust the Government?"

"For both reasons, I suppose," answered Fielding. "But mostly because they don't even understand where their own self-interests lie. Because they believe that this hoarded money will always be worth its full value. Because they distrust everything and everybody, but have complete faith only in their own *visible* stocks of gold or bills."

"Ridiculous!" exclaimed Sloan.

"Sure, it's ridiculous," went on the other, "but they can't see it. What else, I want to know, is going to maintain the value of their hoardings, if it isn't the immense credit and tremendous tax-levying power of our Federal Government? And if that system breaks down, why can't they see that their hoarded money will become practically or totally worthless? And that's the stupidest part of it all—because there can't be any sense in hoarding money and keeping it idle for fear of a *financial collapse* that would wipe out the value of that money!

"Let's go further. These people that are hoarding money think that it will always keep its value as long as the Government's credit *(Continued on page 6)*

UNCLE SAM'S NEW PLAN TO MAKE MONEY FOR HOARDERS

(Continued from page 5)

is behind it. That's right; and the very fact that it is right is also the reason why there is no difference between the safety of hoarded money and money deposited in United States Postal Savings, or in Government Bonds. Both are entirely dependent on the full guarantee of the Federal Government behind them. And, if there is a difference, it is only the one I pointed out before—that hidden money is idle, cannot yield income, and is much more poorly protected against loss or theft than the fully guaranteed Government Bonds or Postal Savings Accounts.

"THAT'S what I meant when I said that hoarders don't even understand where their own self-interests lie. They forget that hoarding is apt to bring about the very calamity they are so anxious to avoid. They are withdrawing money from circulation and thus reducing the country's credit and stifling business production, with all its consequences of increased unemployment and poverty. In the long run this would be bound to hurt everyone. No one would be safe. Capitalist, laborer, or salaried men—all would be directly or indirectly hurt by a further disturbance of our credit structure. Then the hoarder would discover too late for his own good that he had brought disaster on his own head—through his own folly."

"Your 100% right on that score," Warren Sloan said. "These people ought to snap out of it and take advantage of those new 'Baby Bonds' now being issued by the Government. Do you know anything about them?"

"They're simply Treasury Notes," replied Fielding, "paying 2% a year, and available in units as low as $50 each. The one draw-back of this issue is that too many non-hoarders will buy these notes because of their high measure of protection and the justified faith that may be put in the credit of our Federal Government—which, by the way, has the power to tax to the limit if it were forced to do so as a result of hoarding.

"I don't think these bonds should be bought by non-hoarders, but by the other group, who have been withholding their money from circulation through sheer fright or fear. These are the people who should become wise and buy these bonds or buy at even better return the old Liberty Bonds or other United States Treasury Bonds or Notes which are just as safe and good. Or, deposit their money in one of the United States Postal Savings Banks."

Paul stopped the car outside of his house. Getting out, he said, "I'm not against this hoarding business from a standpoint of patriotism. I don't think there's much connection between the two, and—as I said before—if this 'brain-storm' were remedied solely on the logical basis of what is best for each one's self-interest, then the patriotic angle will take care of itself just *(Continued on page 7)*

UNCLE SAM'S NEW PLAN TO MAKE MONEY FOR HOARDERS

(Continued from page 6)

as soon as the average boarder comes to his senses."

"I agree with you there," replied Warren as the two friends parted.

All people who are at any time accustomed to carrying or keeping in their possession rolls of dollar bills larger than is strictly necessary for their daily requirements, can do a lot to help overcome this hoarding situation materially by depositing such excess currency in their banks or by buying Government Bonds or other safe securities. In all these ways they will serve their own individual interests—and also, indirectly, by bringing about greater confidence in general and consequently a more fertile atmosphere for the long-waited improvement of general business conditions.

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

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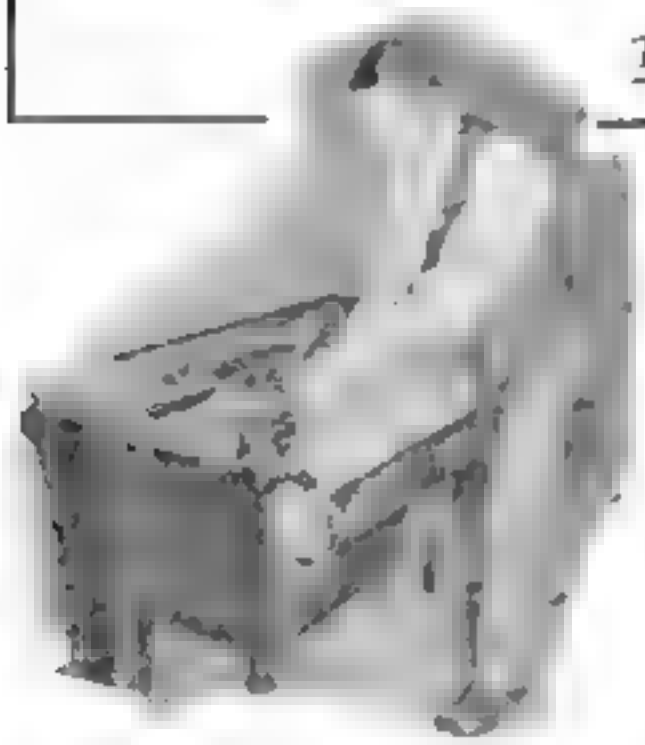

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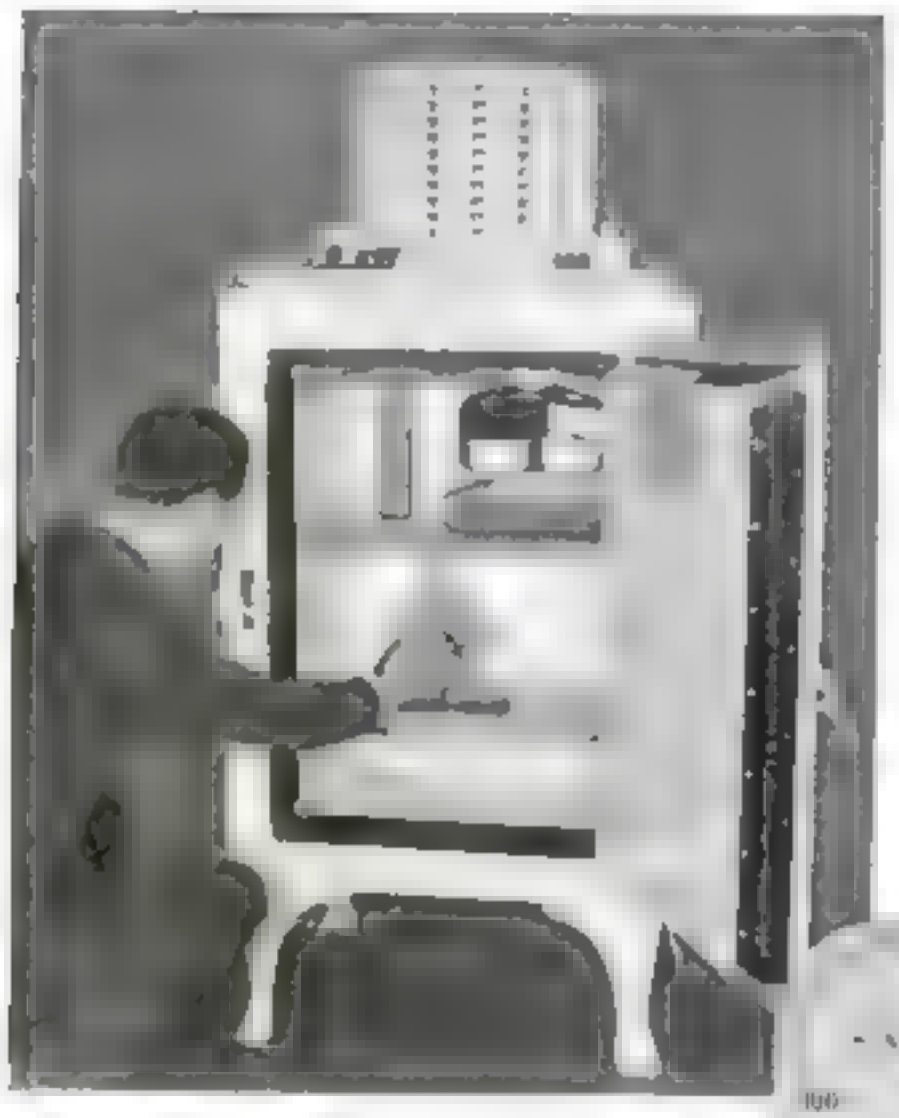

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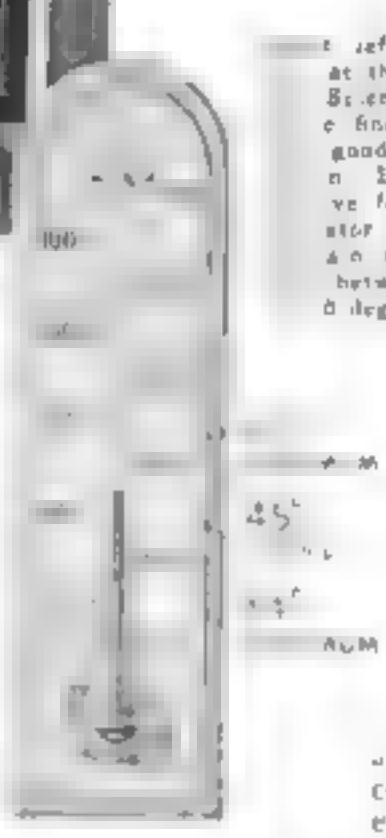

A SIMPLE TEST ANSWERS THIS QUESTION FOR YOU

By
R. M. Bolen

PURE food put in many refrigerators remains pure for but a short time and often after twenty-four hours until for use. This startling fact i based on con tive tes recently ma by officials of the New York City D partment of Hea th. Sam ples of milk c taining 3 000 germs in every fifteen drops —one-tenth the number usually found in Grade A milk—were placed in a refrigerator maintaining an average temperature of fifty-five degrees Fahrenheit In twenty four hours the bacterial count had risen to 18,000, multiply ng six times

Unfortunately, this same incubation of dangerous bacteria is taking place in millions of cheaply constructed refrigerators. Extensive surveys made by the Popular Science Institute have shown that approximately eight out of ten families eat food that has been stored in the home in such a way as to make it a definite menace to heal h

To preserve food and safeguard health, a refrigerator must maintain a constant dry temperature of at least fifty degrees Fahrenheit. This temperature checks the growth of bacteria. True, all bacteria are not harmful. But should food contain typhoid germs or the microbes of ordinary meat poisoning be stored in a temperature higher than fifty degrees, they may multiply to dangerous proportions

Place a good thermometer in your own refrigerator If average temperature is less than fifty degrees and preferably forty-five, you can be sure that foods will remain in their original condition. That is, of course, if the refrigerator is kept clean and is not allowed to become overcrowded

While lack of cold and excessive dampness are conditions generally found in cheap iced refrigerators, there is danger of food spoiling when it is placed in any of the recognized mechanical refrigerators on the market. In the operation of iceless refrigerators and the better iced refrigerators, science points the way to safe household refrigeration.

Iceless refrigerators are now available in a large variety of sizes and can be divided into three general classifications—electric, gas, and oil

Almost everyone at some time or another has let the air out of an automobile tire and noticed the relative coldness of the escaping air. Similarly, everyone who has ever pumped a tire knows that the base of the pump becomes hot. Compression warms a gas and expansion cools it, and it is this swapping back and forth of heat by a gas that makes mechanical refrigeration possible

In electric refrigerators, the gas is compressed in an electrically driven, mechanical compressor. After compression, the gas is cooled and passes through an expansion valve to the vaporization coils which are thereby chilled and absorb heat from the interior of the refrigerator

IN GAS or oil-fired refrigerators, a flame takes the place of the mechanical compressor. The refrigerant gas is dissolved in water and when heated is freed. So rapidly does the freed gas fill the top of the closed container that it becomes compressed. When the compression has reached a desired point, the gas is allowed to expand by being absorbed again in another vessel of water This expansion chills the container

Iceless refrigerators of either type cost little for operation. In average cases, the cost is only a few dollars a month and there is often a saving of as much as two dollars over the usual monthly ice bill, particularly if you have a refrigerator that is inefficient

INSTITUTE BULLETINS

Heating and Ventilating*
Insulation in Building Construction*
Advice on Installing Oil Heat
List of Approved Tools
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NEW LOWER PRICES, now in effect, make the General Electric Refrigerator an even more outstanding value than ever. Substantial savings on all models. New low prices are as low as $187 (f.o.b.) Convenient terms are available—with down payments as little as $10.

The General Electric Refrigerator requires no attention—*not even oiling*. The mechanism is hermetically sealed in steel in the famous Monitor Top—out of reach of dust, moisture and tampering fingers. The sturdy All Steel cabinet is lined with acid resisting porcelain.

The General Electric Refrigerator with its unparalleled performance record is guaranteed against any service expense for 5 years. Select your model now.

Write for a copy of our magazine, The Silent Hostess. It will be sent to you free. Each issue contains delightful recipes, household hints, beauty talks, entertainment plans by noted authorities. Address, General Electric Company, Electric Refrigeration Department, Section M5, Nela Building, Cleveland, Ohio.

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GENERAL ELECTRIC

ALL-STEEL REFRIGERATOR

ALSO MANUFACTURERS OF ELECTRIC WATER COOLERS

Our Readers Say

Finds "Perfect Treasure" Hidden Away in Attic

Recently, while rummaging through an old attic, I received the shock of my life. There piled up in a corner, I found a set of books labeled Popular Science Monthly. Instantly I wondered if they had any connection with the present-day publication. Looking in a recent copy of your magazine, I discovered that it was founded in 1872. Turning to Vol. 1 of the books I had found there was the date to tally exactly with the date of your foundation. So you see this stack of volumes is a perfect treasure and all my own.—H.A.M., Medford Hillside, Mass.

Haven't You Told Him Enough As It Is?

Although I read your "Readers Say" pages with much interest, it is seldom that any letter printed there makes me so darn mad as the one sent in by O.D.E., Galena, Kans. Anyone with any thought at all can pick his "anti-depression" idea apart in about sixty seconds. There are lots of old men over fifty who never did do a lick of work in their lives who would welcome the pension. But does O.D.E. know that the average farmer is now overburdened with taxes and that farm produce is lower than ever before? Butter fat is now sixteen cents where it should be at least fifty cents. I have heard lots of bum ideas for producing prosperity, but this one is the worst! If I knew O.D.E.'s name I would sure tell him my opinion of his idea.—W.A.B., Loveland, O.

Motorcycle Has a Friend Down in Ol' Virginia

I agree with R.A., of Nashville, Tenn., in suggesting you inaugurate a motorcycling page or column. Flying is still too expensive for the person of average means, and the next most thrilling sport is motorcycling. Keep up the interesting articles and cut nothing out. You already have a winner.—D.N.C., Norfolk, Va.

Balance This Old Fox and See How You Get Along

Here's a nice little problem for your readers with mathematical aspirations. I hope it doesn't worry them as much as it worried me. Two hunters wished to determine the weight of a fox they had killed. They balanced a plank on a fence and then balanced one another on the plank. Then they changed places and balanced again, but this time the lighter man held the fox on his lap. If the men weighed 130 and 120 pounds respectively what was the weight of the fox?—A.H., Brooklyn, N. Y.

Michigan Sends Praise to Dr. Poffenberger

I can't refrain from writing to tell you how much I enjoyed Dr. Poffenberger's article, "The Brutal Bully and the Timid Soul." I really think that your magazine should publish more articles on psychology and human behavior, because these are really important branches of science. I think if you put in some good articles on aerodynamics that would acquaint the general public with the feasibility of the airplane, it would be appreciated by all readers.—E.C.W., Munising, Mich.

He Knows What He Wants and Isn't Afraid to Ask

Women if your workshop people can't get it into their heads that a lot of us readers of Popular Science Monthly are just beginners? It's a fact and as a result we like simple things to try our hands on, something that doesn't require elaborate tools but can be visualized instantly and put together with no possibility of misunderstanding directions and being obliged to do the whole job over again as has happened to me! That goes for the talk about model railroads and the stuff on photography. All that dope may be fine for the advanced students. I wouldn't know about that, but it's way over my head and I wish you'd tell your writers to get down to earth and give us the interesting trifles that are fundamentally sound and appealing to anyone who has a trace of ingenuity. Please, you other workshop fans, speak your minds on this.—C.W.C., Prekel, N. Y.

Old Railroader Sees Passing of Steam Locomotive

I was greatly interested in reading in a recent issue of your magazine under the title "Is the Iron Horse Doomed?" your article dealing with transportation. I have been a railroader for seventeen years, and before starting to work I played in the yards near my home. I mention this to show that I have some right to an opinion. I think there is a new era coming that will be an iron horse powered by electricity that will be operated with an economy hitherto undreamed of. There are many sides to this question, one of which is that by electrifying a railroad several expensive units at large terminals will be done away with, such as cinder pit, turntables, and the labor for their maintenance. The round house will go out of existence, and small buildings, pleasing to the eye, will be built near the stations. The smoke, grime, and grease of the present will disappear. With the installation of electric power heating in trains and waiting rooms will be better and more economically provided. Twenty-four hours could be cut from the scheduled run on a trip from Chicago to the Pacific Coast. There are an endless number of things that will be done to increase efficiency and reduce costs when the railroads put electricity into general use. Yes, I think the steam from horse is doomed.—U.R., Topeka, Kans.

Botanists and Cooks, Please Answer These Questions

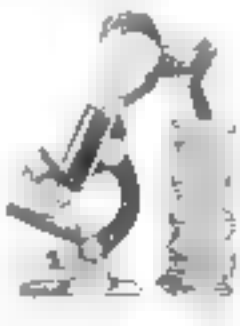
Popular Science Monthly has been one of my favorite magazines for years. At present there are two subjects I should like to see discussed in your publication. First, cooking and baking. What I want to know is, just what change takes place from raw ingredient to the finished product ready to eat? Second, what is the fundamental difference between annuals and perennials that enables the latter to live through the winter and grow up in the spring from its own roots? There must be a difference some place. Maybe it's in the construction of the cells or in the composition of the sap. Surely some of your readers can shed some light on this, to me, very interesting and baffling subject.—H.B.L., Burley, Idaho.

Be Kind to the Scientists but Criticize What They Say

I want to correct F.P., who spoke his piece in a recent issue of Popular Science Monthly. He says that the scientists who were mentioned in your article on astrology expect the public to believe every word they say. That is not the case. Their statements are always open to criticism. Although I have not studied astrology and can give no opinion on it, I feel sure that F.P. has not studied astronomy enough to realize that the statements to which he objects were not positive and closed to criticism. I move that readers do not get so sore in their letters to Popular Science Monthly. E.W.D.'s solution of the engine problem is correct, in my estimation. You certainly have a good magazine.—R.A.R., Lawrence, Kans.

Does Anybody Else Want Articles on Microscopes?

There must be many adults like myself who are, or could be, deeply interested in working with a microscope. My own instrument cost $18 and magnifies up to 300 diameters. I have also a kit of chemicals, slides, etc. (cost $10.50) that enables me to mount and preserve specimens, thus collecting a fine library for future use. I imagine young people would also be much interested in this. Therefore, I should like to see more articles in your magazine about the use of popular



priced microscopes as a hobby. Why not ask your readers to express themselves on this subject? If enough replies are received I'm sure you'll print more along this line. Come on, microscope fans, write to the Editor.—E. D. W., Rochester, N. Y.

Please Tell This Flyer If He Holds a Record

In a recent issue of Popular Science Monthly I read an article by Assen Jordanoff in which he tells of students who flew alone after brief instruction. He told of one Army lieutenant who soloed in three hours and twenty minutes. He also mentioned a Long Island girl who soloed after two hours and twenty-seven minutes at dual controls, which he claimed is the record. I have proof that I soloed after one hour and thirty minutes instruction. I made three half-hour flights with a transport pilot and then went up alone and flew for twenty minutes the first time and for ten minutes the second. Is there anyone who has beaten that record? Would like to hear from others on this matter and set me right if I am wrong in claiming this record.—A. L., Marinette, Wis.

Who Are We to Say You're Wrong About This?

Probably like all your knockers and volunteer correspondence helpers, I could suggest changes in your magazine that I might like. Nevertheless, if you removed some part of the magazine to enlarge some other part, I feel sure I should miss it, and it would destroy the feeling that Popular Science Monthly is well balanced and complete as it is. Probably your editors have their present jobs because they know more about the magazine than do the knockers.—F. W., Great Neck, N. Y.

Mysterious Stone Doughnuts Used in Grinding Corn

The mysterious stone doughnuts, shown in a recent issue of Popular Science Monthly and described as a puzzle to scientists, interested me greatly. These same stones, as shown in the picture you published, appear identical with stones I possess which were taken from Indian camps in Coffee County, Alabama. I also have two much larger stones in bowl shape. These, it seems, were used in connection with the two smaller ones to grind Indian corn and other grain. Possibly scientists have not noticed the various parts of this crude grinding implement. I am told by old Indians in this state that the stones were certainly used in the making of bread.—R. F. S., Brewton, Ala.

That Radio-Controlled Plow Hits a Couple of Snags

I should like to ask J. J. L., of Miles City, Mont., what he would do if his radio-controlled tractor plow struck a rock and came unhooked, or if a bunch of Russian thistle slid in and plugged up the plow? Or what would he do if the mold-board stopped scouring? What dial on his radio would he adjust to clean the dirt off the board? If he had to follow his plow with a gas eating machine, he might as well ride the tractor and so save a little.—F. R., Cathay, N. D.

Wet Moon and a Hot Fire Rout Old Superstition

One subject that interests us out here in Michigan is the effect the moon has on crops that are planted in either its light or dark phase. One farmer is sure positive that for a bumper yield root crops, like potatoes, should be planted in the dark of the moon and leaf crops, like cabbages, should be planted in the light of the moon. He also says the moon should be consulted as to the best time to burn brush when clearing second growth timber land. I decided to test this. One rainy day I stuck a newspaper into a pile of brush and lighted it. It didn't catch with the first match and I heard my superstitious friends say I was foolish to try and burn the brush during a rain and at the wrong phase of the moon. With the second match the paper caught, ignited the brush, and the whole thing burned merrily. What, I'd like to know, has the moon to do with it?—J. C. L., Iron Mountain, Mich.

After This, Belgium, You Better Behave Yourself

Just read your article on the radium strike in Canada. No, I'm not going to beat it for Great Bear Lake, but this gives me an excuse to get something off my chest. Fact is, your radium story merely emphasizes the fact that Belgium has, for a long time, been a bad actor among nations. Ever since old Leopold got busy in the Congo and committed atrocities at which the world still shudders, Belgium has been reactionary, selfish, and downright mean. Her attitude toward the African radium fields and the humanitarian treatment of cancer is characteristic. Why don't the decent nations take those pitchblende fields away from her and develop them so the price of radium will be within reason? If anyone has a good word to say for Belgium, I'd be glad to hear it, because I like to be fair to everyone.—C. C. B., Mason City, Ia.

You Can See at Once There Isn't Room for Everything

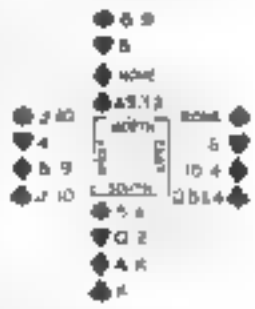
I write to ask if you could not devote a section of your wonderful magazine to electrical experiments and things that can be made, such as novelty lamps? Also let's have a larger radio department with space given to "radio trouble," "radio questions and answers," and "short wave data."—J. R. S., Trenton, N. J.

Explanation of What Keeps Windmill Plane in Air

Well, V. V. S., here is how the autogiro works. The blades of an autogiro revolve about an axis (fixed to the fuselage of the aircraft), free to move up and down or in a horizontal plane by means of universal joints at the rotor hub. The blades are inclined so that when entering into the air stream, or advancing forward, they have a negative angle of incidence determined by the speed the rotor is to turn to give the proper lift. The angle of attack of the blades in relation to the air is such that the blade entering forward is lifted up, or tends to fold up against the hub. However, the rotation of the vanes causes centrifugal force to hold the blades extended. The lifting force, being perpendicular to the blades, is at an angle to the axis of the rotor (due to the negative angle of incidence), inclined forward from the axis. Thus the blade, in addition to lifting up, is also lifting ahead. This force of lifting and pulling on the blade rotates it around the axis, and after a quarter turn the next blade takes its place. The retreating blades also lift, but due to traveling with the air stream past the craft, give less lift than the advancing blades. Thus they set at a more nearly horizontal level than the advancing blades, causing the apparently lop-sided appearance seen in photos and in flight.—R. D. H., Ashley, Ind.

A Little Applied Science for You Contract Players

I know as well as you do that this isn't in your line but I should like to give "Our Readers Say" fans a chance at it. We've tried it until I'm dizzy, and if I don't get a solution pretty soon I'll be bugs. Here it is. Six tricks of a bridge hand have been taken, leaving seven to play with cards distributed as follows: North, heart, 5, spades, 8, 9, clubs, ace, 9, 3, 2. East, heart, 6, diamonds, 10, 4, clubs, queen, 8, 5, 4. South, hearts, queen, 2, spades, 5, 6, diamonds, ace, king, club, king. West, heart, 4, spades, jack, 10; diamonds, 8, 9, clubs, jack, 10. South leads and is required to take six tricks, hearts being trumps. Lay this out and see how easy it is to take five tricks. Hurry up and tell me how to take the sixth.—J. W. L., Easton, Pa.



Turn Back to Page Twelve, Mathematical Puzzle Fans

Please print some more mathematical puzzles on the "Our Readers Say" pages. I believe that good puzzles of this sort require a better analytic ability than many of the problems in mathematics that are given in colleges.—G. B., Portland, Ore.

This Stamp Collector from Maine Has an Idea

I am writing you this letter to compliment you on your good work and to make a suggestion. There are many in the United States who are interested in stamp collecting or philately. Probably many more would like to enter the ranks of the philatelists but do not know how to start. I suggest that you have some expert prepare a series of articles giving the elementary facts of philately. I always read what "Our Readers Say" first and must say that some contributors are certainly selfish in wanting a magazine with just the things that they themselves like with no thought of the other readers. I hope the time never comes when I have to miss an issue of your magazine.—F. L. W., Cumberland Mills, Me.

You Might Ask the Boy to Stop Eating Cherries

I have a rather perplexing question to ask: Is the limb of a cherry tree under greater strain when the small boy, sitting on it reaches out and pulls in the tip branches of the limb than it is when he is sitting in the same place but is not pulling in the twigs? It is no use telling you what I have done on this problem, because I work an hour and then get right back where I started. I have even watched a limb under the condition indicated but have reached no conclusion. Maybe some of your readers will understand what I mean and be able to tell me the right answer in words we can all understand.—R. D. T., Stamford, Conn.

Men and Women of America:

RECONSTRUCTION Is in YOUR HANDS!

★

You have studied "depression" charts. You have heard "depression" speeches. You have read "depression" articles. You have dreamed "depression" nightmares.

If you are ready now to forget "depression" and give a thought to faith, common sense and reconstruction, come with us through this page.

☆ First, some figures—

By the end of 1930, the national wealth of America had reached the astounding sum of one hundred and ninety *billions*—one hundred and thirty-four billions more than in 1914, an increase of 71%.

In our savings banks and trust companies, we have stored up more than twenty-nine billions.

In safe-deposit boxes, in private hiding-places of all kinds, we have a billion or two more.

We have, ready for use, more than nine and a quarter million bales of cotton, valued at about three hundred millions; and four hundred and twenty-nine million bushels of wheat valued at more than two hundred and fifty-seven millions.

We possess uncounted millions of feet of unused lumber, tons of unused coal and wool and steel.

What do these stupendous figures mean?

That America has more resources than the next six nations—and can stand on its own economic feet.

That, if these resources are put to work, instead of being allowed to lie idle, America will rapidly approach a normal condition and benefit all the other nations of the world by showing a way out.

The Re-Employment Drive Is On, Too!

In nearly 11,000 cities and towns, local civic bodies, the labor organizations, employers in industry and commerce, and the American Legion, have joined together to put men and women back to work immediately. They are succeeding—by adding work, by making work, by spreading work. Already, community after community has reported employment increases. Each new employee means a new purchaser for more products of more workers. That's the circle which leads to prosperity. Go to your local organized headquarters and ask what you can do to help.

Let's put this wealth to work—NOW!

We're going to put this wealth to work—we're going to do the sort of thing we did in 1921. Back there, three years after the war, when the country was in the depths of economic despair, the War Finance Corporation helped lead us into the light of an unprecedented period of prosperity.

"We steadied the situation," said Eugene Meyer in the reconstruction year of 1922, "by taking over the slower loans that were good, removing the necessity for forced liquidation and putting the banks in position to carry their customers for a longer period and to make new loans where adequate security could be obtained. *But our loans have done more than this—they have provided that element which is so necessary in all businesses—the element of confidence.*"

The Reconstruction Finance Corporation, of which Mr. Meyer is Chairman and General Charles G. Dawes is President, has been empowered to use a vast fund of two billions of dollars to relieve credit stringency, to strengthen the sinews of business and to restore faith.

Let's get behind it and push!

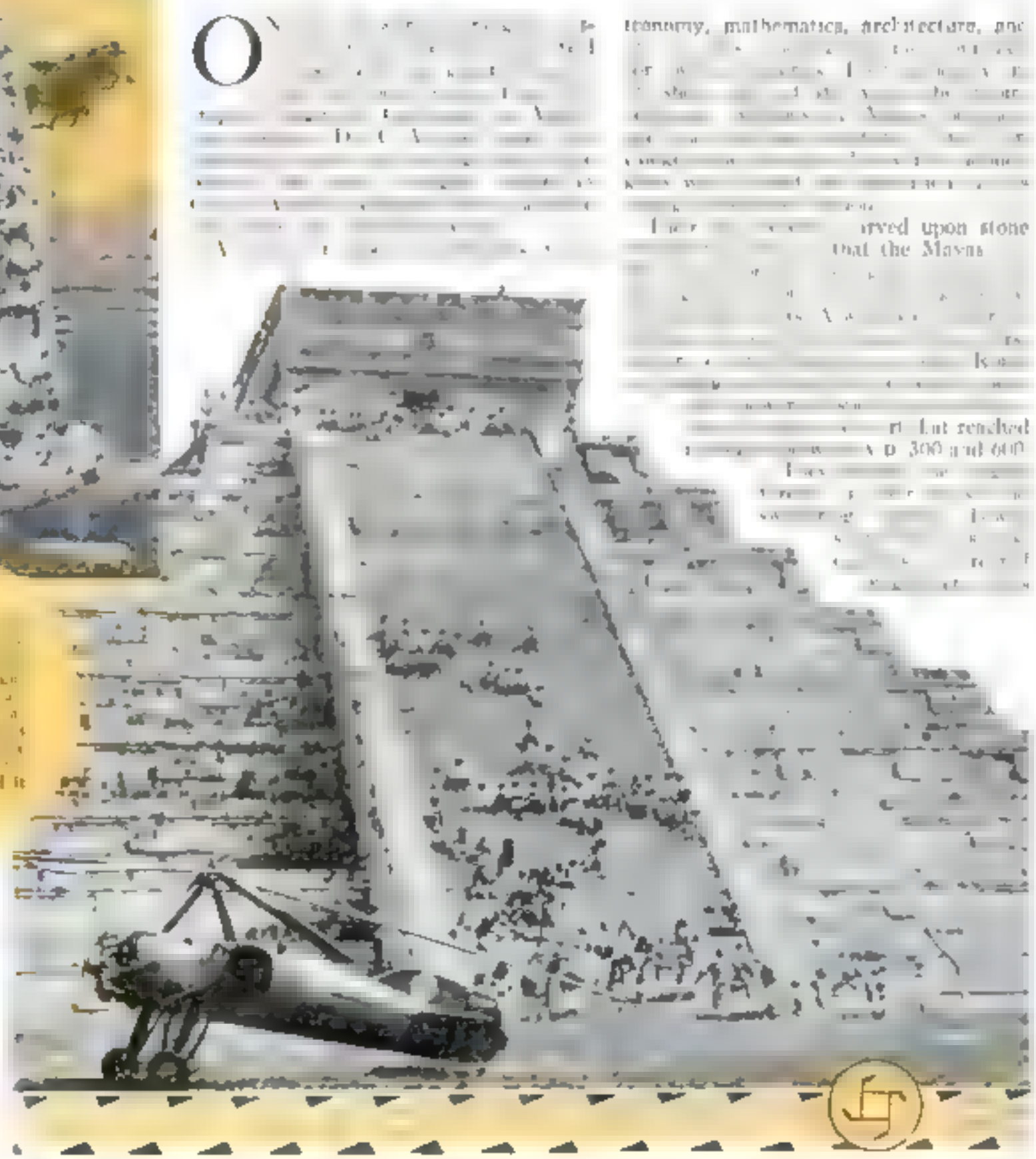
THE NATIONAL PUBLISHERS' ASSOCIATION

"As the most nearly self-contained nation, we have within our own boundaries the elemental factors for recovery."

(From the Recommendation of the Committee on Unemployment Plans and Suggestions of the President's Organization on Unemployment Relief)

POPULAR SCIENCE
MONTHLY
May 1932 Vol. 120, No. 5
RAYMOND J. BROWN, Editor
SIXTY-FIRST YEAR

MYSTERY OF America's Lost Empire SOLVED AT LAST



By ROBERT E. MARTIN

Here the new and the old are brought into startling juxtaposition as an autogiro lands at the base of the ruins of a temple raised by the vanished Mayas, whose living descendants can be seen on the steps, centuries before Columbus set sail

amid intensely cultivated farms. They built towering temples to their gods, splendid palaces for their kings; massive public buildings; huge astronomical observatories.

The Mayas were the Greeks of the West. As sculptors, painters, craftsmen, and jewelers, they surpassed the ancient Egyptians. They produced handsome pottery, and were highly skilled in spinning and weaving. They were astute businessmen and thoroughgoing farmers. Across their swamps they threw stone causeways that have proved better time-defiers than the famous roads of the Romans. Above all, they were marvelous mathematicians and astronomers. Because of their amazing command of those sciences, they were able to devise a calendar superior in accuracy to our own.

For centuries, the Mayan Empire and its cultured people prospered. But between A. D. 580 and 630, when the country's civilization

An ancient edifice of the Mayas, now known as the Temple of Warriors and Columns. In the foreground, an autogiro that carried scientist to the ruin

Ancestors of this man, who now lives in the jungles of Honduras, were once the rulers of a mighty people in Central America. How they fell from their high estate is explained in this article

At left, a relic of the long ago found in the midst of the ruins in Central America

Floods carrying soil from hillsides into the valley to fill up the lakes are blamed as one of the agencies that wrecked the Mayan Empire. In China elaborate systems of terraces are used to prevent this erosion. Would the same system, if the Mayas had hit upon it, have saved that nation from destruction?

was at its height, and its population numbered more than 14,000,000, the Mayas abandoned their wonderful cities. They left their farms, their homes, their palaces and temples to the ravages of the jungle. It is only within the last twenty years that persistent digging has brought back to light a number of these priceless relics.

Hosts of Mayas died in the fateful fifty years of the collapse. The survivors fled from their Guatemalan homeland. Some settled in various parts of South America. Others migrated to western Yucatan. Here they laboriously rebuilt what they had lost, but this so-called Second Empire never recaptured the glories of the first. When Cortez and his conquerors came in 1519 the Mayas long had fallen victim to the warlike tribes of the North and their old grandeur was a mere memory.

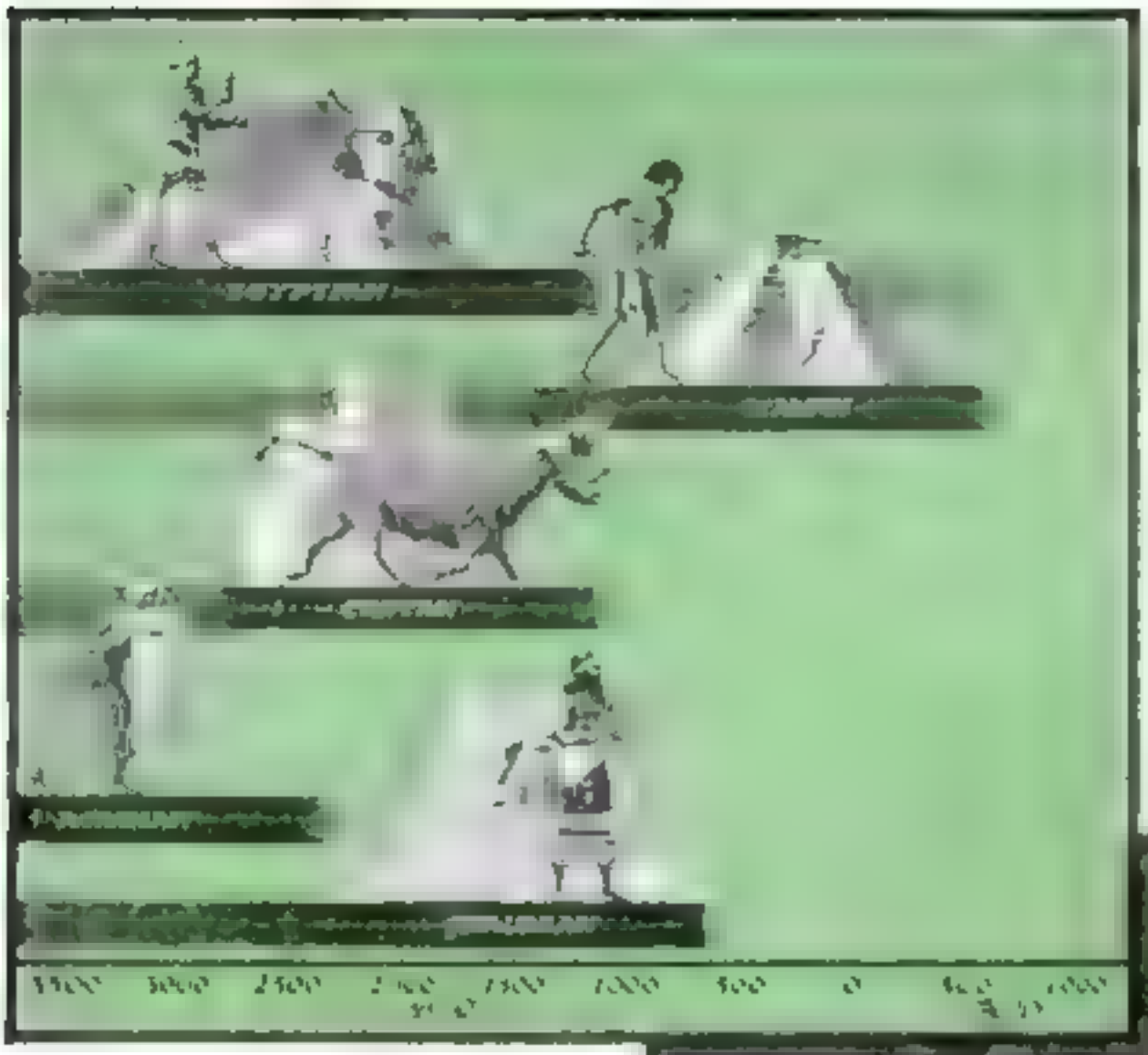
Who or what destroyed the First Mayan Empire? What kind of calamity befell this keen, progressive race of which nothing remains today but a handful of poor, illiterate Indians? Investigators who have tried to solve the mystery have advanced various theories. Some laid the collapse to a long and suicidal civil war. Others believed a blight withered the Mayan crops and a great famine swept away vast portions of the population. Still others reasoned that an epidemic, probably of yellow fever, a series of earthquakes, or a drastic change in climate were responsible for the tragedy.

All this admittedly was guess work. No facts ever were brought forth in support of any of these hypotheses. Now, for the first time, an expert offers an explanation based not on speculation but on carefully collected evidence. Dr. Cooke, the man who gathered it and worked out the new theory, is a member of the U. S. Geological Survey. He recently returned to this country after many months of exploration and study of the Peten district of Guatemala, the ancient seat of the First Mayan Empire. The investigation was made at the instance of the Carnegie Institution of Washington.

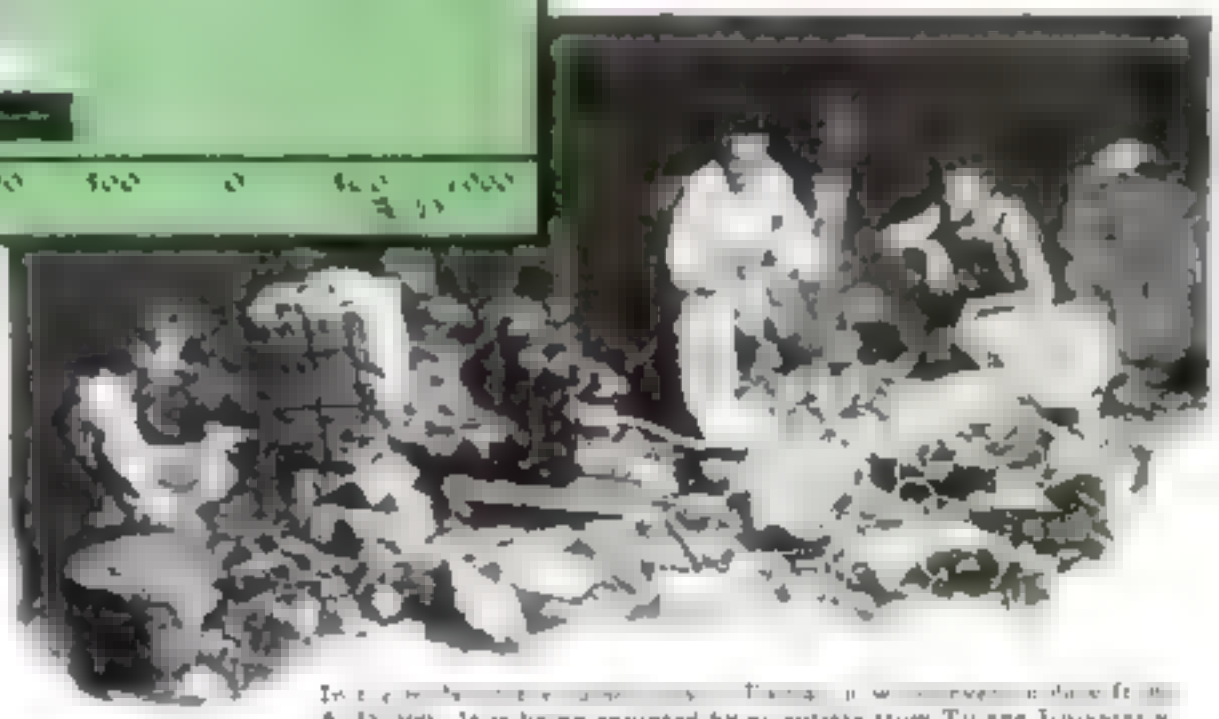
COOKE found the secret in the swamps and marshes that constitute about forty percent of the old Maya country, now again an almost impenetrable and uninhabited wilderness. He made a close study of the soil and formation of these bogs, or *bajos*, and of the uplands surrounding them. The lowlands are flat, muddy plains, overgrown with gnarled, stunted, thorny trees, that are flooded during the six months of the rainy season. The uplands, rising at some points to a height of hundreds of feet, are wooded with large trees, including mahogany and chicle.

His survey of the terrain and his tests of the composition of the soil led the geologist to these conclusions: The marshes, at the time of the Mayan Empire, formed a system of deep, clear lakes. The Mayas built their great cities and tilled their farms on the surrounding hilly shores, where their jungle-covered ruins are found to this day. The lakes they used for navigation, shipping their farm produce and articles of commerce by boat from settlement to settlement. This, incidentally, explains how they solved their transportation problem, for so far as is known they had no beasts of burden and, with all their ingenuity, they never invented the wheel.

As the Mayan population increased, the



CIVILIZATIONS rise and fall and the history of the world records the passing of many of them. What is it wiped out the once mighty nations whose rise and passing are suggested in the drawing at the left? This article, founded on lately discovered facts, tells why Mayas lost in their fight with nature. It is possible the others also perished because environment changed and they could not meet the new conditions.



A D 900 It is being executed by artists from Tulane University and will be reproduced at the World's Fair in Chicago next year

...tations cleared more and more of the ... lands to make ... ches for the ... other crops, thus exposing the rich black soil to the torrential tropical rains that drench the territory during six months of the year The fine, fat lands gradually were eaten away and washed down into the ...kes, which eventually became mere mud pools, unfit for navigation

Here, then, were two factors that might well impoverish any country—soil ... des roving for the farm lands and cessation of transportation, ruling commerce Those conditions, though they might reduce a prosperous nation to poverty and even famine, could not wipe out millions of people in the space of half a century

Disease did the rest. The silting of the lakes changed them into pestilential breeding places for mosquitoes that spread malaria and yellow fever among the population. In the fifty years of the collapse, epidemics of these diseases must have swept over the Mayas. Powerless to stem the tide of death, the terrified survivors fled from their plague-stricken country

Such, in brief, is Dr. Cooke's explanation. Leading authorities on Mayan history agree that it furnishes the first logical and acceptable solution of the age-old problem. Dr. Clark Wissler, curator-in-chief of the Department of Anthropology of the American Museum of Natural History and a recognized expert on ancient American culture, whose interesting discussion of Stone Age civilization is presented in another part of this issue, emphatically endorses Cooke's conclusions

"There is no doubt in my mind," Dr Wissler told me the other day, "that Dr Cooke has found the solution of the Mayan mystery. We always suspected that either famine or disease, or perhaps both had a great deal to do with the Mayan collapse, but there was no scientific basis for these speculations. Dr. Cooke has supplied the facts we have been looking for

Now that we have them, it is easy to picture what happened to these people Natural forces defeated them They were hit by a terrific depression compared to which our present slump is a boom period. From masters of fine, fertile acres, they became poor dirt farmers, and finally found it practically impossible to raise anything on their stony fields.

Meanwhile, the filling in of their lakes, which robbed them of their best means of transportation, made life toilsome and difficult for them. They had no dray or pack animals, and no carts or other land vehicles. So, when their lakes became muddy bogs, they had only one way of carrying their provisions and merchandise from place to place—on the backs of men Destitute, bewildered by misfortune, half starved, they lost their grip long before malaria and yellow fever dealt them the finishing blow. No wonder they left their country and tried to start life afresh in other places."

In commenting upon the preliminary report of Dr Cooke's studies, Dr A. V Kidder, head of the Division of Historical Research of the Carnegie Institution, declared the geologist's conclusions to be entirely plausible. A similar opinion was expressed by Dr. Oliver Ricketson, Jr., who for the past five years has been in charge of the Institution's excavating activities in Mayan territory His own extensive observations in the field, said Dr Ricketson, had convinced him that there was a mass of evidence in substantiation of Dr Cooke's theory.

Dr. Herbert J Spinden, curator of ethnology of the Brooklyn Museum, who is considered the foremost authority on Mayan culture, amplified Cooke's findings with an interesting interpretation of the workings of the Mayan mind. Dr. Spinden has made fifteen trips of exploration in the country of the Mayas and has devoted many years to the work of deciphering their famous calendar

Like all other Central American peoples, Dr Spinden told me, the Mayas were fatalists. It is true that they had an amazing knowledge of astronomy, but their priests used this knowledge to control the rank and file by playing upon their superstitious fears. It is likely that, just about the time the events described by Dr. Cooke began to happen, the priest-astrologers saw evil portents in the sky. They made dire predictions, and the natural phenomena that followed seemed to justify these gloomy prophecies. This *(Continued on page 116)*

Trapped by BLACK LIGHT

A [illegible] a substantial, though cleverly concealed, wire

Frauds such as these are practiced deliberately by some self-styled "mediums" to extract money from the credulous. Probably even larger is the number of [illegible] these are part of Dr Schroeder's up-to-the-minute equipment

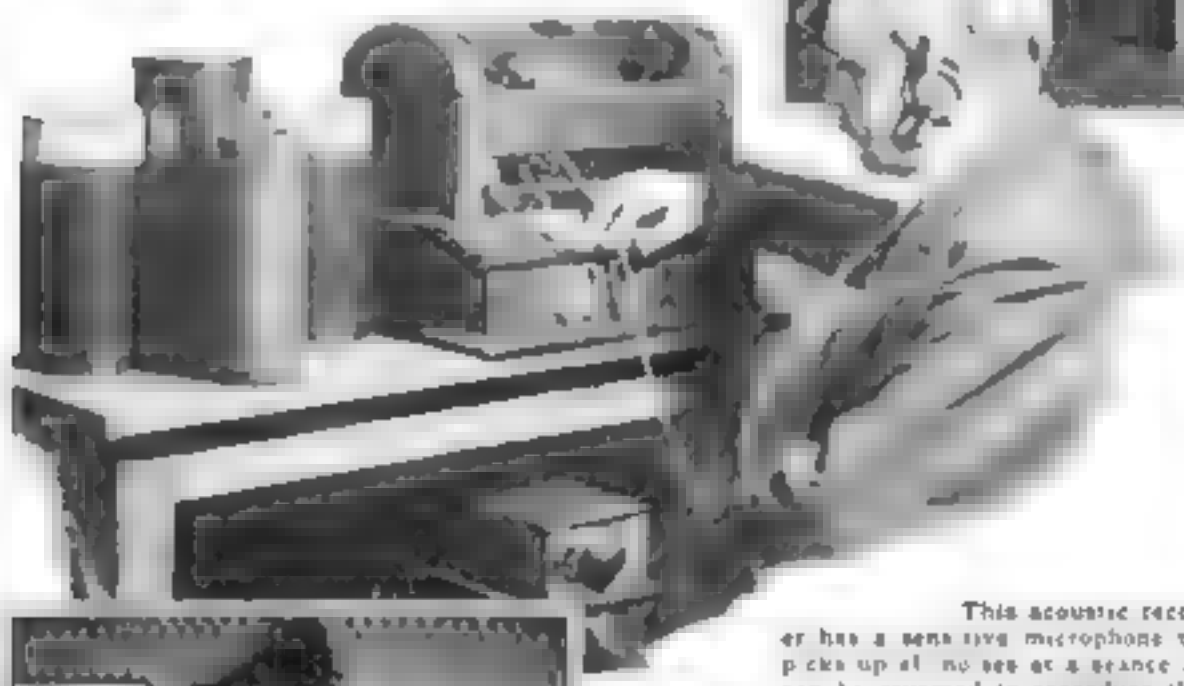
In a typical seance the pitch black room is flooded with the invisible ultra-violet from special lamps covered with opaque screens. A lens of quartz transparent to the rays, replaces the usual

Invisible black light was used to make this typical move of a medium who claimed to be able to make a table walk. The camera proved that the "medium" was a fake and clearly shows that the foot was used in manipulating the table

REPORTS of a strang
"house of mystery" in Germany
reached this country not lon
ago. Here, it was said, camera
that could see in the dark and
secret electrical apparatus
betrayed the trickery of spir
tualistic mediums. Our Berli
correspondent investigated thi
extraordinary laboratory, and
the accompanying article is
the result

By
Rene Leonhardt

Observers at this seance were startled when the chair whizzed through the air but a camera had no trouble finding the wire on which it moved



This acoustic recorder has a sensitive microphone that picks up all noises at a seance and can be reversed to reproduce them

This honest "medium" used her thumbs to lift the table but wouldn't believe it until the ultra-violet ray photos convinced her She didn't know why her thumbs were beneath the table's edge, the cold investigators

glass lens in the camera. Sitting at a table in the darkness is the medium, wearing tinted goggles as a protection from the rays. Every action of the medium is photographed, together with the face of a second-clock and measuring sticks to supply data to accompany the pictures.

This apparatus demonstrated not long ago how easily some "mediums" innocently deceive themselves. A woman appeared at the laboratory and assured Dr Schroeder that she was "psychic." In the encouraging darkness of the laboratory she made small tables rise from the floor by placing her palms upon them. A motion picture of the performance made in the darkness by invisible light revealed the woman as a crude trickster. Her thumbs were plainly visible beneath the table's edge and she merely lifted it with her hands. Shown the photograph, she became indignant. She insisted that her thumbs had nothing to do with it but could not explain why they were there

A skilful "medium" can perform baffling tricks even though each of his hands is apparently held by an observer during the performance. Sleight-of-hand may enable him to free one of his arms, leaving the observers unwittingly holding on to each other Then horns begin to sound, and ghostly fingers brush the observers' faces. Dr Schroeder has devised a method of "electrical chaining" from which the best sleight-of-hand artist cannot escape The medium is made a part of a delicate electrical circuit which includes the objects placed in front of him upon a tabletop of insulating material. Contact between them and any part of the medium's body will close the circuit and take a flashlight photo revealing the trickery

One experiment in Dr Schroeder's strange laboratory provided a real mystery. During a seance with a noted medium, the observers were startled by a ghostly cry, unlike any that human voice or mechanical means might produce. All the observers' impressions tallied, with the exception that one man was not certain he had heard the cry. That gave Dr Schroeder his clue. He set up a microphone and sound-recorder in the room and repeated the seance. The same weird cry was heard in the midst of the proceedings. When they were over, Dr. Schroeder eagerly examined the sound record. There was not the slightest trace of the strange noise, although the voices of everyone present were plainly recognizable. Only one conclusion was possible—there had been no cry!

Such a mystery is not impossible of explanation. At best the human eye and ear are imperfect recording instruments, and they are wholly unreliable in a darkened room and under the strain of excitement. How a medium can hoodwink an entire group of persons at once is harder to explain—yet it is a recognized phenomenon called "group suggestion."

There is no tricking a soulless group of scientific instruments, such as Dr Schroeder has assembled in his laboratory Day by day, he is learning the truth about the frauds of fake mediums.

Demand for SILVER

STARTING from almo
every city and town we
the Missouri River a
of the Sierra Nevad
5,000 men are invading the
deserts of the West
From the Indian villages of Can-
da, Mexico, and South America,
a prospector force, nearly equal
numbers, is afield. They started
last October and they are on the
trail of silver, a metal man has
not sought for more than half a
century. T
bankers believe silver is coming back to stability and to purchasing power in the markets of the world.

This army of prospectors, surpassing in number any that has gone into the waste lands since the Alaskan gold rush, is traveling in airplanes and automobiles, steamships and trains, though by far the greater number are walking behind patient little burros, just as the Phoenicians did when they sought silver in Spain, more than twenty centuries ago

More than $5,000,000 has been expended by their backers and themselves in the United States alone in outfitting the pioneers of the latest silver rush. Probably twice as much has gone into the more extensive equipment of the "plateros" and "dorados" who are penetrating the mountains of Mexico and South America. These figures come from state mining bureaus, the larger mine-operating corporations, and individual engineers, who also furnish the estimate of the number of silver prospectors now afield. Though the mining and refining of gold and silver have undergone great improvements in the last fifty years, the prospector's pick and shovel, pan and rocker, still are the only adequate tools for the discovery of the metals

If one prospector finds another "Comstock" in the United States, or another "Potosi" in Bolivia, he will enrich the world by more than a quarter of a billion dollars worth of the white metal In 1859, barely ten years after the discovery of gold in California two prospectors digging a ditch to their placer claim near what is now Virginia City, Nev uncovered a hard black mass about four fe
der ground Washed in the rocker, it proved to be a grayish-white metal, unlike the gold which they were seeking

They sold this claim for a sum reported at $1,200 to $1,500. In the next thirty years, it produced more than $300,000,000 worth of silver and gold, and is remembered in mining history as the Comstock Lode, the richest body of silver ever unearthed in the United States. The prospectors clung to their placer gold claim, which soon ended in nothing, and both died in extreme poverty. The only other silver mine in the world that compares with the Comstock is that near Cobalt, Ontario, Canada, where the ore runs as high as 200 pounds of pure silver

For 400 years the burro has been used by the prospectors, and modern conveyances have not yet wholly displaced it

Starts New Rush in West

By H. H. DUNN

Compressed air drills are now used to cut out blocks of the ore

to the ton, far more valuable than the average gold ore worked at a profit.

Three centuries before the Comstock discovery an Indian goatherd, clambering up a mountain in Bolivia, pulled a shrub up by the roots and saw his own face reflected in a band of shining white metal, nearly two feet wide. Thus was found the Potosi mine, from which approximately half a billion dollars' worth of silver, with some millions in gold and other millions in lead, have been taken.

Pedro Navarro, a Mexican *mestizo* muleteer, camped one night on a mountain trail near Guanajuato. He rested the flat slab of slate on which he toasted his *tortillas* on half a dozen other small stones. When he put out his fire, he noticed that one of the stones was "shining white," softer than the others, and could easily be cut. Not far from the trail, he found the vein of almost pure silver "more than a meter (39.37 inches) in width."

[illegible] he old records, and reported his find with samples in the city. Work started on a large scale but the Indians rose and drove out the Spaniards. Since then that vein has never been rediscovered.

The history of silver is studded with lost mines. Tunnels and ditches, where prehistoric Indians "gophered" for surface silver, are found from Patagonia to Alaska. The Chinese used silver more than 4,000 years ago. The Greeks and the Romans made their wine goblets of electrum, an alloy composed of twenty percent gold and eighty percent silver. So far as we know, the Lydians were the first to coin gold and silver as money, and the rich silver deposits of what is now Spain brought on the Punic Wars between Rome and Carthage.

ONE ounce of silver, costing thirty-four to thirty-six cents to produce, and worth about forty cents in gold, has been drawn into a wire more than three miles long and hammered into a leaf one-ten-thousandth of an inch thick. Silver is the most malleable of all metals except gold and the most ductile of all except platinum. If it were cheap and plentiful, it would replace copper, since it is the most nearly perfect conductor of electricity known.

Nearly three quarters of the world's population uses silver for money, yet only one third of the world's production is coined. In the United States the annual use of the approximately $35,000,000 worth of silver mined each year is in industries, arts, and sciences. One tenth of all this production goes into the manufacture of photographic films and papers. From it may be made one of the most dangerous and powerful of explosives, silver fulminate, which, when dry, will explode if touched with a feather.

Silver always has run gold a close race for value of production. All the mines of the world, during the 435 years from 1493 to 1928, produced $21,120,298,527 worth of gold, and $18,521,220,049 in silver or about $2,600,000,000 less. Yet only 1,021,655,069 fine ounces of gold were mined to make the total, while nearly 14,500,000,000 ounces of silver were mined. Today, there is approximately eleven billion dollars worth of gold coinage in the United States, while it is impossible even to estimate the value of the silver coinage of all the countries using this metal.

When the prospector has found his silver vein, only the most adventurous part of the production of silver has been accomplished. Then comes one of the most interesting *(Continued on page 117)*

10,000 Aircraft Patents

Can YOU Invent One of These?

Famous Test Pilot Describes in This Article Twelve Major Inventions That Flyers Need

1. Variable Wings. 2. Free Wheeling Propeller 3. Light Seaplane Anchors. 4. Amphibian Landing Gear. 5. Substitute for Wheels. 6. Motor Silencer 7. Take-off Device for Flying Boat. 8. Gas Gage 9. Landing Light. 10. Blind Flying Indicator. 11. Wiper for Windshield. 12. Stable Helicopter.

By Captain Frank T. Courtney

NEARLY 10,000 aircraft patents have been issued in the United States alone. Yet, they fail to answer a number of problems designers are seeking to solve. Any one of a dozen inventions will be worth a fortune to the man with the right idea—if he can steer clear of three pitfalls that entrap most designers of aerial innovations.

A few years ago, an inventor came to me with a plan for preventing the formation of ice on wings. His scheme was to have pipes running back and forth inside the wings, carrying hot exhaust gases from the engine. It was not an original idea and future ships may have hollow boxes of stainless steel forming the leading edges of the wings for exhaust pipes. When I asked the mechanic how much his metal tubes would weigh, he replied: "Oh, not much." Then we figured it out and found the "not much" was considerably more than 400 pounds, a prohibitory figure.

The first thing every inventor in the field of aircraft should remember is that each ounce of added weight is important. I recall one case in which engineers spent two whole years in research work in order to cut down the weight of a big ship only 160 pounds. Every ounce that can be taken out of the weight of the structure goes in the pay load, or passenger and freight carrying capacity of the plane. Consequently, the first question a manufacturer asks concerning a new invention is: How much does it weigh? The more it weighs, the more certain is it to be rejected.

In sixteen years of engineering work and test flying, I have seen hundreds of ingenious devices lose out because they weighed too much. On a big 18,000-pound passenger plane, like a Curtiss Condor, a saving of 600 pounds seems small. It is only one thirtieth of the total weight. But it is *one sixth* of the passenger load and means that the income on every flight would be increased a sixth without any additional operating expense.

Every pound that is added to the weight of the ship must be subtracted from the pay load it will carry. In this constant battle to increase the carrying capacity of planes by reducing their weight, heavy innovations are sure to be refused.

At the same time, strength cannot be sacrificed. Usually, when an invention is light enough, it is too weak; when it is strong enough it is too heavy. In calculating strength, the inventor must not only consider the strain his device will stand when first installed. He must also know what it will bear up under when parts begin to wear and wobble. The snapping of a small part in the air may throw an extra strain upon a larger part and result in a serious structural failure. The inventor should always be sure his invention is strong enough.

On one big ship I tested, the tail was designed to move on two large bearings. As they wore away, little by little, the increased play allowed the tail to shake, putting sudden extra strains upon the structure. It required frequent tightening of the bearings to keep the ship in good condition. Any feature of a plane that demands frequent adjustment is bad. Inventions so complicated that they may get out of order unless they are gone over every few days are not wanted. The design of an aircraft innovation must be simple.

PRACTICALLY every aircraft invention that fails to get serious consideration is rejected because the inventor neglected to observe these cardinal rules. They are so important that I put them at the beginning of this article. If you nail them up on the wall of your workshop before tackling the inventions aviation is looking for, they will save you time and grief.

An English mechanic, several years ago, brought me plans he had worked out for a queer "grasshopper" flying machine. It was a tractor biplane with lower wings designed to fold back along the body when the ship was in flight, changing it into a monoplane and thus reducing resistance and increasing speed. The difficulty was that when the wings were braced sufficiently to withstand the sudden shifts in pressure, as the surfaces swung backward through an arc, they became so heavy the idea was impracticable. Some scheme for changing the area of wings in flight, without adding to the weight, is one of the most needed ideas in aviation. So, we will put at the top of our list of wanted inventions.

1. *Wings of Variable Area*

A PLANE can never go as fast on the ground as it can in the air. Consequently, it needs more lifting surface at the take-off than it does in flight. A machine that could expand and contract its wings like a bird, decreasing the area in flight and increasing it at the take-off and landing, would be a big step forward.

Hundreds of inventors have tackled this problem. Some have produced sliding tips, others swinging tips, and still others adjustable extensions that could be moved in and out at the rear of the wings. Practically all of them required gears and bracing that weighed so much that the added surface needed to support this extra weight more than offset the advantage of the invention. It is known that the added area should come at the tips rather than the back of the wings. When the wings are made wider, instead of longer, the drag, or resistance in passing

leave Big Problems Unsolved

through the air, increases rapidly around landing speeds.

Perhaps the development of some super-light-and-strong metal may make it possible to construct variable area wings that weigh no more than present supporting surfaces. In the engines that powered some Schneider Cup racers, the pistons and some other parts were made of magnesium. This metal is light and hard. Its defect is that it corrodes easily. Sea water eats into it as acid eats into tin. However a new noncorrosive magnesium alloy, called MG7, has just been announced in Germany for aircraft use. The metal that appears at present to be the best combination of lightness and strength is beryllium, a laboratory product literally worth its weight in gold. Some aircraft engineers calculate that when the price of this rare "gray gold" drops to $50 a pound, it will pay to use a beryllium alloy in the framework of planes.

II. *Free-Wheeling Propellers*

ANOTHER badly needed innovation is "free wheeling" for propellers. When an engine cuts out in the air, the wind keeps the propeller whirling against the drag of the balky engine. This slows up the blades, adding tremendously to their resistance in passing through the air.

Thus, when one wing-engine stops on a tri-motored ship, the other two motors not only have to keep the plane in the air but also have to drag along the revolving blades that turn over the dead power plant. Some sort of simple "free-wheeling" device in the transmission line that would allow the pilot to disengage the propeller from the engine and let it spin free, if the motor quits, would be an improvement welcomed by airmen. This innovation must be light, adding little weight to the plane, simple, reducing the danger of its getting out of order; and, also, strong enough to transmit the power.

III. *An Anchor for Seaplanes*

WHEN the *DO-X* flew across the Atlantic and then cruised up along the coast of South and North America to New York City, it carried at the nose of its huge flying boat hull a big metal anchor resembling those on ocean liners. The bigger the seaplane, the larger and the heavier the anchor required to hold it when it is floating at rest on the water. In flight, this heavy mooring iron has to be taken along, eating up power and cutting down the load the plane can carry. In the "wanted" column of inventions is a new kind of anchor for flying boats and seaplanes that does not depend so much upon weight for its holding power.

IV. *Amphibian Landing Gear*

IMAGINE a nine-ton truck going a mile a minute over a rough field. That is the sort of strain the landing gear on a big plane sometimes has to stand. The difficulty in designing amphibian machines able to come down either on land or water, is to get the folding or lifting mechanism of the wheels strong enough without making it too heavy.

Hundreds of amphibian gears have been invented. Scores have been built. But none is completely satisfactory. An entirely new type of amphibian landing equipment is needed.

In one of the early seaplane competitions, before the

(Continued on page 119)

AIR CONQUEROR OF TOMORROW

Drawing suggesting the triumphant plane of the future, shows the many devices and changes that are still needed to give man complete mastery of the air. Inventors throughout the world are now busy in workshop and on flying field trying to solve the problems that so far have proved too hard

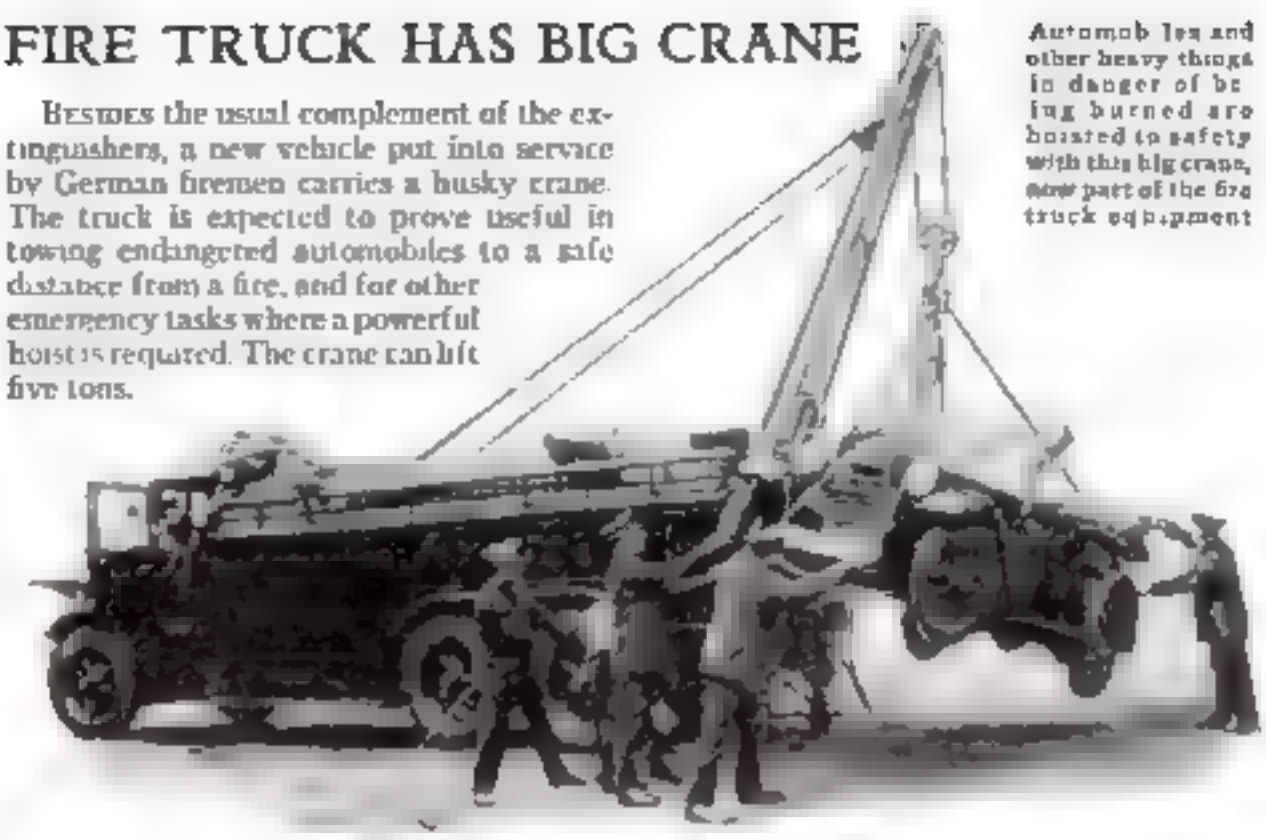
ONLY LUCK CAN WIN IN NEW ELECTRIC GAME

PURE chance controls an amusement device known as the "thyratron speed trap," recently designed by electrical engineers. The object of the game is to roll a steel ball, representing an automobile down a runway without lighting any one of three lamps. Should a player succeed, he is said to have escaped the "speed trap." Usually, however, a light flashes upon one of three figures, bearing legends, "Constable Thyra fines ten dollars," "Sheriff Thyra fines twenty dollars," and "Judge Thyra fines thirty dollars."

As the ball rolls down, it successively closes three electric circuits leading to as many thyratron or vacuum tubes, which act as relays to operate the lamps. Because of an ingenious combination of direct and alternating current supply coupled in series to each tube, whether the tube operates at all depends upon the point at which the ball catches the alternating current cycle. This changes sixty times a second, and luck alone determines whether it will reenforce or cancel the direct current at the moment the ball makes contact.

FIRE TRUCK HAS BIG CRANE

BESIDES the usual complement of the extinguishers, a new vehicle put into service by German firemen carries a husky crane. The truck is expected to prove useful in towing endangered automobiles to a safe distance from a fire, and for other emergency tasks where a powerful hoist is required. The crane can lift five tons.



Automobiles and other heavy things in danger of being burned are hoisted to safety with this big crane, new part of the fire truck equipment

NEW ROBOT WILL DIAL YOUR PHONE

Pressing a lever on the box-like device seen in the photo above automatically dials the phone for any one of fifty numbers

WHEN a German inventor found the task of looking telephone numbers burdensome, he did not bewail the mechanization of the service in the interests of efficiency. Instead, he went the telephone engineers one better and invented an automatic dialer. Stops, on this device, are preset for the fifty numbers most frequently called. A knob on top of the attachment is moved to the desired number. Pressing a thumb lever at the front of the device does the rest. The fifty numbers may be changed at any time to correspond with a new list.

OLD MINE NOW DANCE HALL

WHEN inhabitants of West Winfield, Pa., go to a dance or a basketball game they descend 300 feet underground. Their recreation hall, one of the most unusual in the world, is a thirty-by-seventy-foot chamber in an abandoned limestone mine. Social and athletic events are held under the glare of electric lights strung along the rocky walls.

In the chamber of an old mine, 300 feet below the surface of the ground, West Winfield, Pa., has furnished a recreation and dance hall

PRINTS WITHOUT SETTING TYPE

ANYBODY can operate a new machine that prints 1,500 show cards a day, for it works as easily as a typewriter. No setting of type is necessary. The device is provided with a row of holes, each representing a letter or figure. The desired character is printed by moving a punch over the proper hole, and pulling a lever forward. Cards may be printed in two colors at a single operation. According to the inventor, the device prints signs at a fraction of the cost of ordinary printing, and turns out work of more finished quality than could be done by hand.

New German cargo plane, weighing seven tons, driven by 1,000-horsepower engine, will lift 5,000 pounds of freight

AIR FREIGHTER TO CARRY 5,000 POUNDS

WHAT it takes to transport 5,000 pounds of freight through the air is shown in the photograph, above, of Germany's latest cargo plane. Yet a load of this enormous size may be carried at a substantial profit, according to the operators. So large is the single-motored air giant that it has two rudders, mounted one above the other, and special ailerons to give it the necessary amount of control surface

Equipped for a flight, the big Junkers plane carries more than a ton of gasoline and 175 pounds of oil. Its total weight, loaded, is more than seven tons. The body is all-metal, and a 1,000-horsepower engine drives the freighter of the skies.

SIX CAR AIDS IN ONE

Six automobile accessories are combined in a single new attachment installed on a car's front fender There is a driving mirror and signal arrow to indicate turns, a side floodlight, a small white lamp providing a parking light that can be reversed to serve as a trouble light, and entire unit is a fender guide

Mounted on front fender car accessory shown at the right combines seven in one with spare, lights, guides

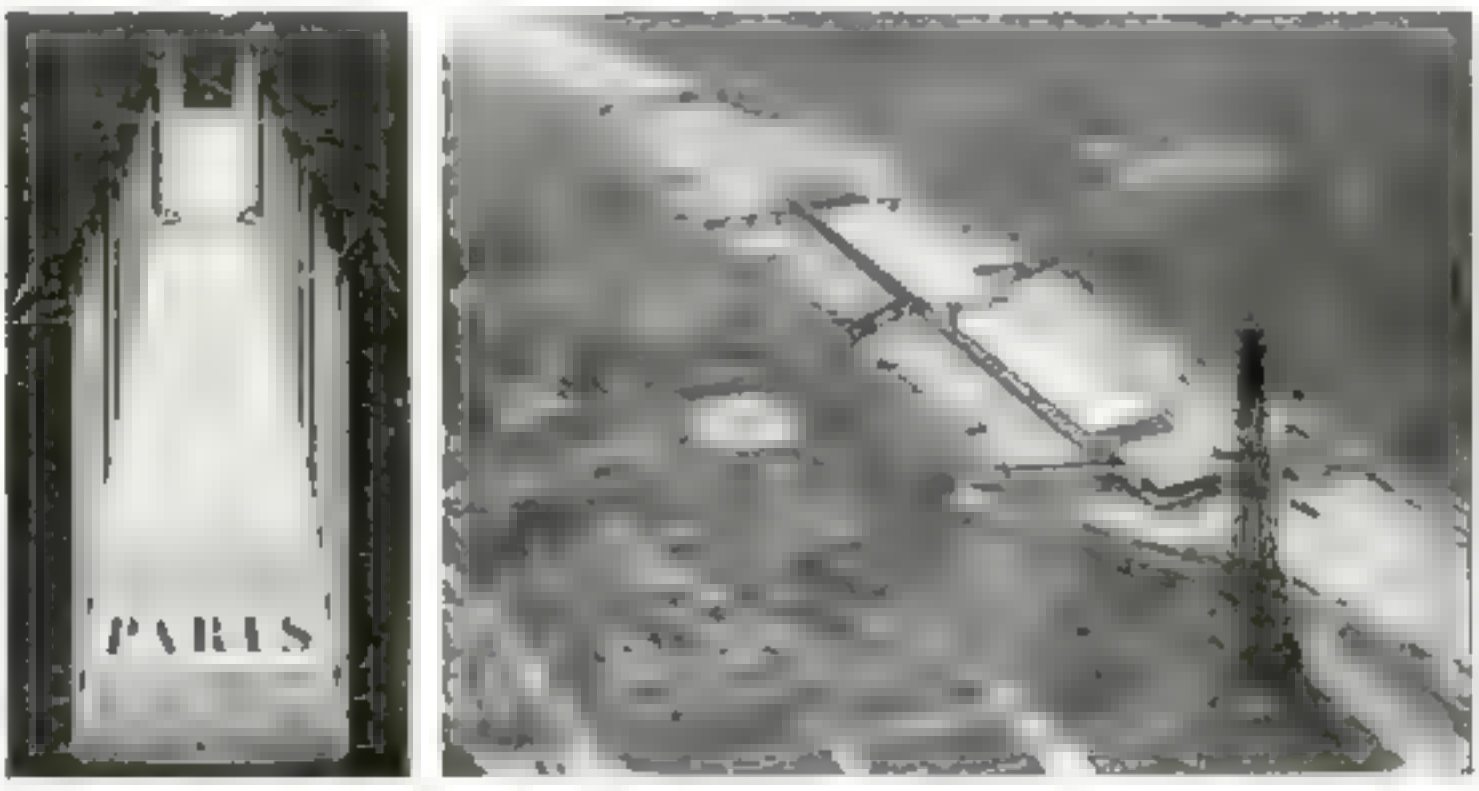
Flare with its carrying parachute

NEW AIRPLANE FLARE HELD BY PARACHUTE

CAPT C F M. CHAMBERS, World War ace and former pilot of the Royal Flying Corps, recently journeyed to the middle of the Atlantic to test a new parachute flare he has invented for aviators. Fired from a pistol, the flare does not ignite until it reaches considerable elevation. Then a parachute opens and keeps it in the air for as long as three minutes, while it burns with a light of from 50,000 to 500,000 candlepower The designer declares it a much-needed aid in making a forced landing at night Because of the delayed ignition the flare can also be fired from a plane circling about looking for a landing space

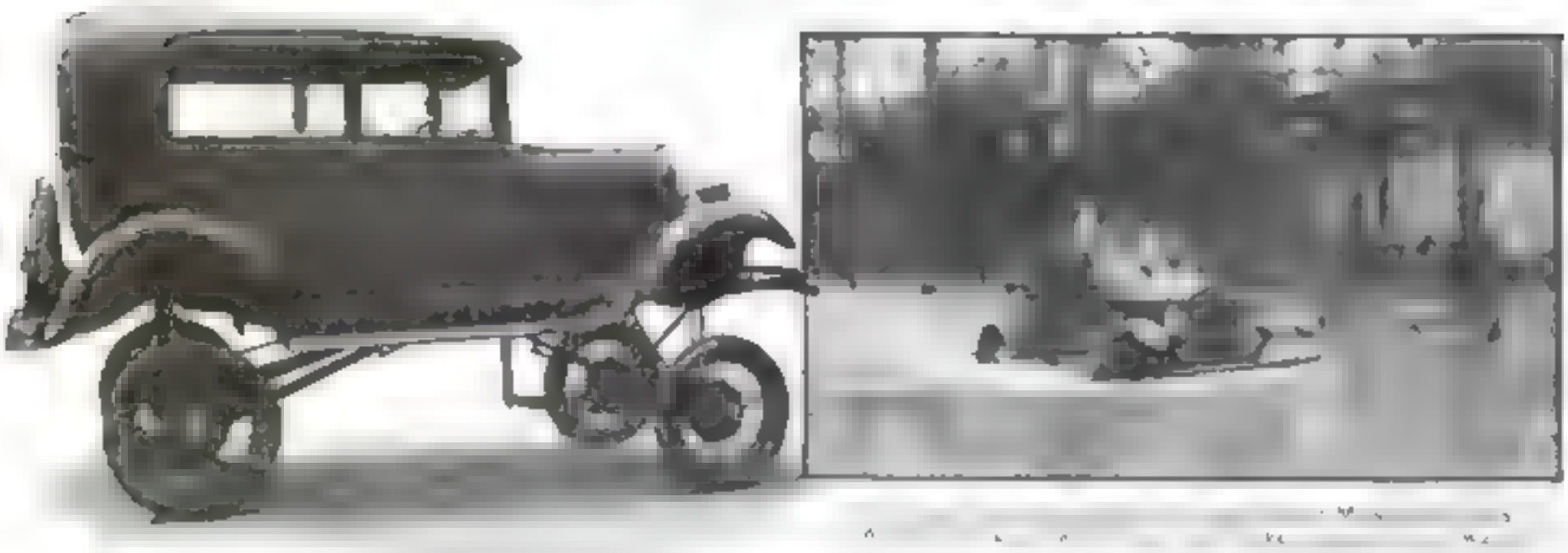
PLAN AIRPORT IN RIVER TO LET PLANES LAND IN CITY

A new scheme enabling airplanes to land in the heart of a great city, instead of at airports in distant suburbs, has been suggested by a young French architect, Andre Lurcat. He proposes the erection of an artificial island resembling the deck of an airplane carrier in the middle of the Seine River, which bisects Paris. With such a terminal, airline passengers could land in the shadow of the Eiffel Tower and within a few minutes' ride of the business center according to Lurcat. Similar mid-river landing fields might solve the air traffic problem of New York and other large cities situated on rivers or other bodies of water



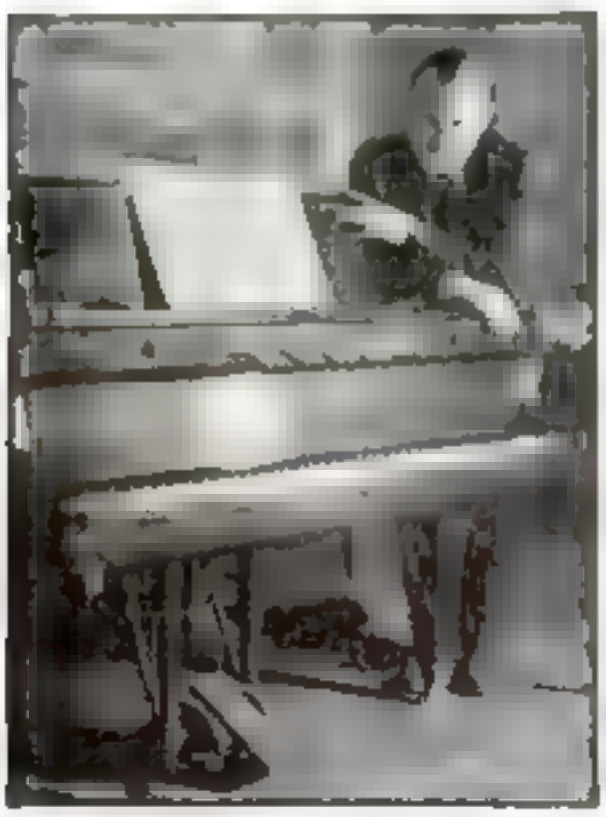
Airplanes may land almost in the heart of cities with an airport set up on a river as is proposed for the Seine, Paris

PUT CARS ON STILTS TO TRAVEL FLOODED ROADS



WHEN flood waters recently inundated towns in the Yazoo River region of Mississippi, ordinary automobile traffic was brought to a standstill. But a few resourceful inhabitants of Greenwood, Miss., had their cars raised upon "stilts," so that the body rested several feet above the undercarriage and wheels. Then they splashed as they pleased along the flooded highways. A truck owner also engaged in a ferry business to carry motor tourists past the flooded region. State highway officials objected when he ferried a loaded gasoline truck for eight miles, and forced him to quit because the combination of water and heavy loads was crumbling the road surface.

RADIO PIANO GIVES PIPE ORGAN TONES



Benjamin F. Miessner with his newly-invented piano organ that has a wide range of tones

Tones varying in timbre from the tinkle of a music box to the sonorous voice of an organ come from an amazing new type of piano invented by Benjamin F. Miessner, radio engineer, of Short Hills, N. J. It permits piano effects hitherto impossible, including a "swell" produced with an organ-like pedal. The new piano has no sounding board, and when the hammers strike the strings, the vibrations are picked up electrically and amplified, and are heard through a loudspeaker. This permits control of the timbre through a series of stops in front of the player.

According to the inventor, his instrument could be placed on the market at a cost little, if any, higher than that of the ordinary fine piano. He foresees that a new school of composers will arise to write music especially for instruments of this type.

AIR PROPELLER DRIVES BIKE

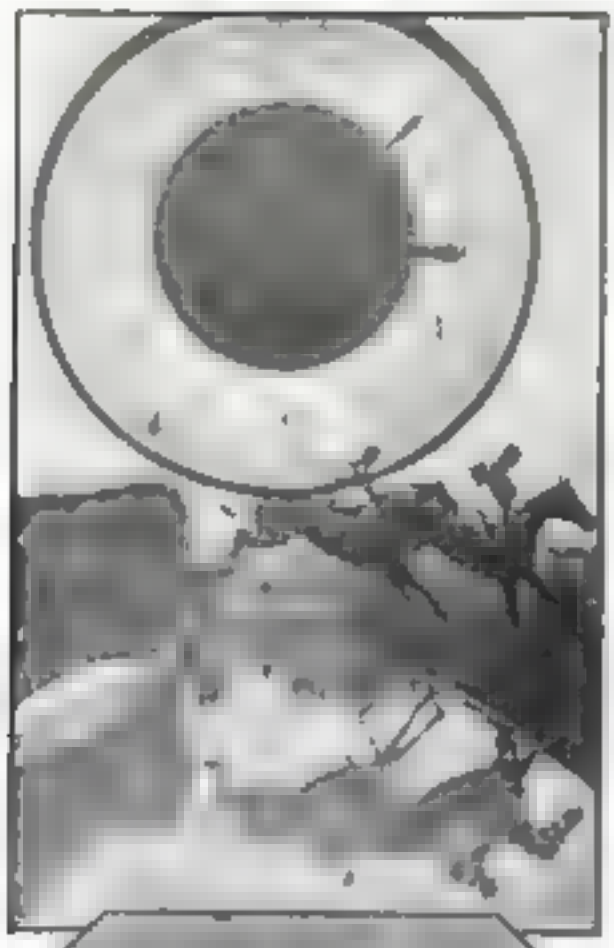
DESIRING something unusual in vehicles, a mechanic of Kensington, England, built himself an air-propelled bicycle. Instead of being connected to the rear wheel, the pedals are linked through a sprocket and chain to a huge propeller at the rear of the machine. With this strange apparatus, the builder declares that he has attained speed of fifteen miles an hour. It is his contention that driving the propeller with the feet requires less power than is necessary on the ordinary machine. This, he says, is particularly true in climbing hills or in riding into the wind. However, he admits it is a curiosity rather than a practical invention.

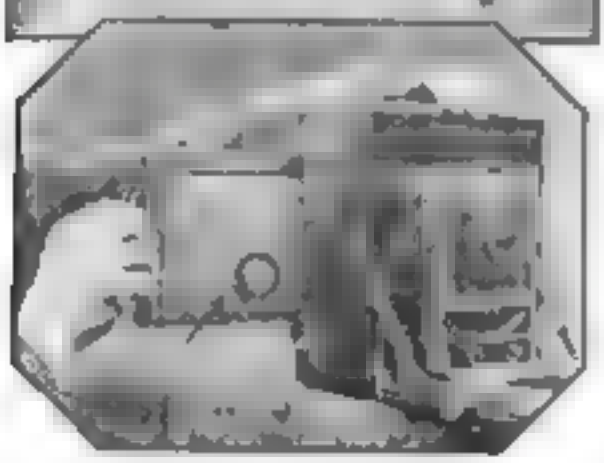
BIG BIBLE IS STAGE TO ILLUSTRATE SERMONS

TO MAKE his sermons on the parables more vivid, a Cincinnati pastor has constructed a stage in the form of a Bible ten feet high, and set it up in view of the congregation. It is closed during the beginning of the service, but when the text is given out, the Bible is opened. Then, with colored lights for illumination, living characters enact the scenes touched upon in the sermon.

REAL BALL LIGHTNING MADE IN LABORATORY

BALL lightning, one of the most mysterious of natural phenomena, is reported to have been produced synthetically in a laboratory at Leeds University, England. By passing high-voltage electrical discharges through a smoke cloud, the experimenters were able to obtain balls that seemed to float in the air.





WATCH SET IN CAMERA SHOWS TIME OF PHOTO

One of the simplest of attachments to record the image of a watch upon a photograph for timing sporting events, was recently devised by an ingenious Richmond Hill, N. Y., news photographer. He mounted a special watch with a large transparent dial and a tiny movement on his plate holder, in front of the sensitive emulsion as shown in the lower photograph. Every picture consequently bears the time stamped upon it whose the transparent dial cuts off none of the picture as shown in the upper photo. A stem wind, like a sol[illegible] would have obstructed the view, so this timer was built to order by a jeweler to wind and set from the front. It is called the first of its kind.

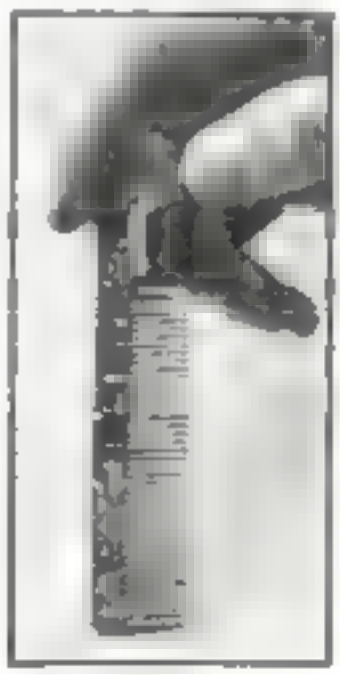
ELECTRIC ALARM FINDS HIDDEN PISTOL

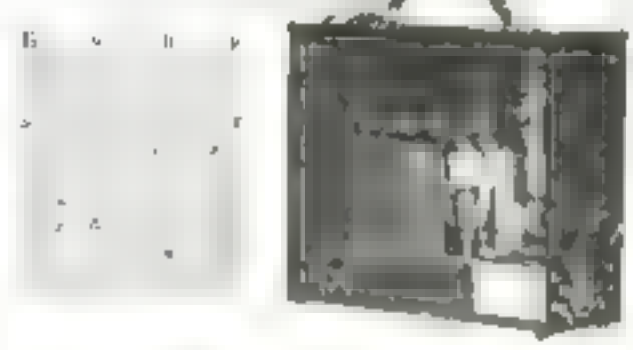
No person carrying a [illegible] can walk undetect[illegible] electrical "bandi[illegible] cently demonstrate[illegible] Western Univers[illegible] crime detection labo[illegible] alarm bell rings, an[illegible] shutter clicks, taking a graph of the suspect.

The brains of the device is a radio-like apparatus housed in a small suit case and connected to a pair of magnetic coils placed on either side of a door or passageway. Any bulky metallic object, such as a concealed pistol, disturbs the magnetic field, actuates the control mechanism and sounds the alarm. Tests were scheduled at the Joliet, Ill., penitentiary to determine if the invention would bar saws or files in packages to prisoners.

CLIP ON COMB HOLDS IT SAFE IN POCKET

Pocket combs with clips like those on pencils, are a handy item for women. Difficult to lose when attached conveniently to a coat, vest, dress, or shirt. The clip is a sturdy band of spring metal that slips over, and clings to, the edge of a pocket in exactly the manner the clip on a pen or pencil works. The comb can be clipped to the pocket in a woman's hand bag so it will neither be lost nor be inaccessible. The comb should prove especially useful to those who have an outdoor [illegible]





EMERGENCY CHAINS GET CAR OUT OF MUD

Not every motorist has the forethought to apply tire chains before he gets [illegible] or a snowdrift are "mud tire chains" now on the market, which may be applied without jacking up the car. Two or three of these [illegible] provide for ready attachment, give the wheel a firm grip on the road. They may be used [illegible] wooden or wire spo[illegible]

When caught in the mud or snow, this emergency chain will help motorist get his car started

SNAKES HAVE NO SPEED, RECENT TESTS PROVE

Popular belief that snakes travel with lightning-like rapidity was proved [illegible] by tests at the University of Ca[illegible] in which several species were timed and observed. The celebrated "blue racer" snake moves at but two and a half miles an hour, a pace corresponding to a man's slow walk.

EVEN FISH NOW GET A BATH

[illegible] sh a bath may seem a paradox [illegible] it is being done at the U. S. Bureau of Fisheries in Washington, D. C. Experts have found that a dip in a tub of water containing a few drops of acetic acid will rid a fish of parasites that cling to its scales. The photograph at left shows one getting its "health bath" before being shipped to an aquarium. It is found that dipped fish stand the journey better than undipped.

INDUSTRY'S MAGIC WAND CREATES

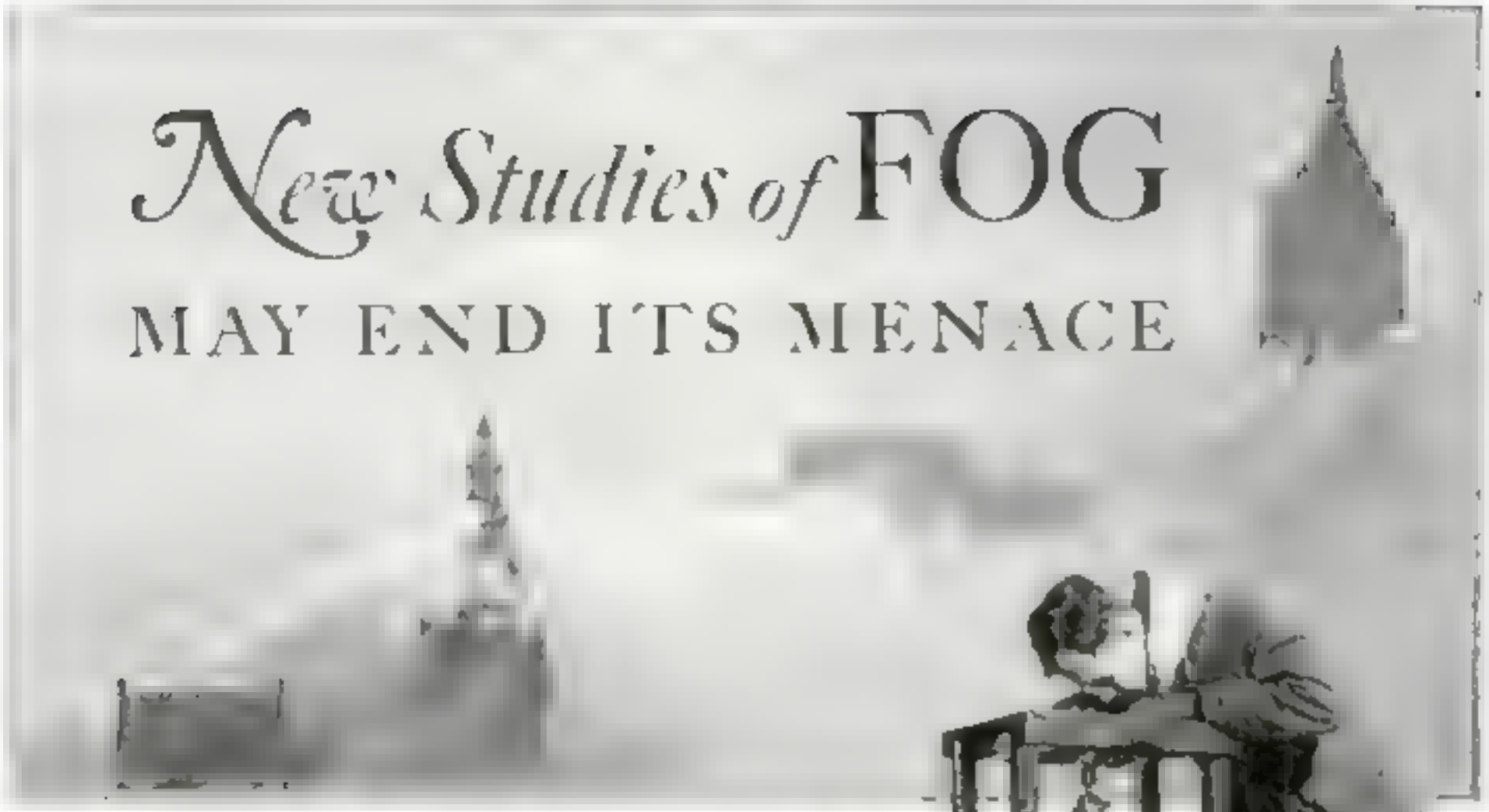
Pottery *from the* Air

being shaped in flat, shallow molds

one for each color seen in photo

New Studies of FOG

MAY END ITS MENACE

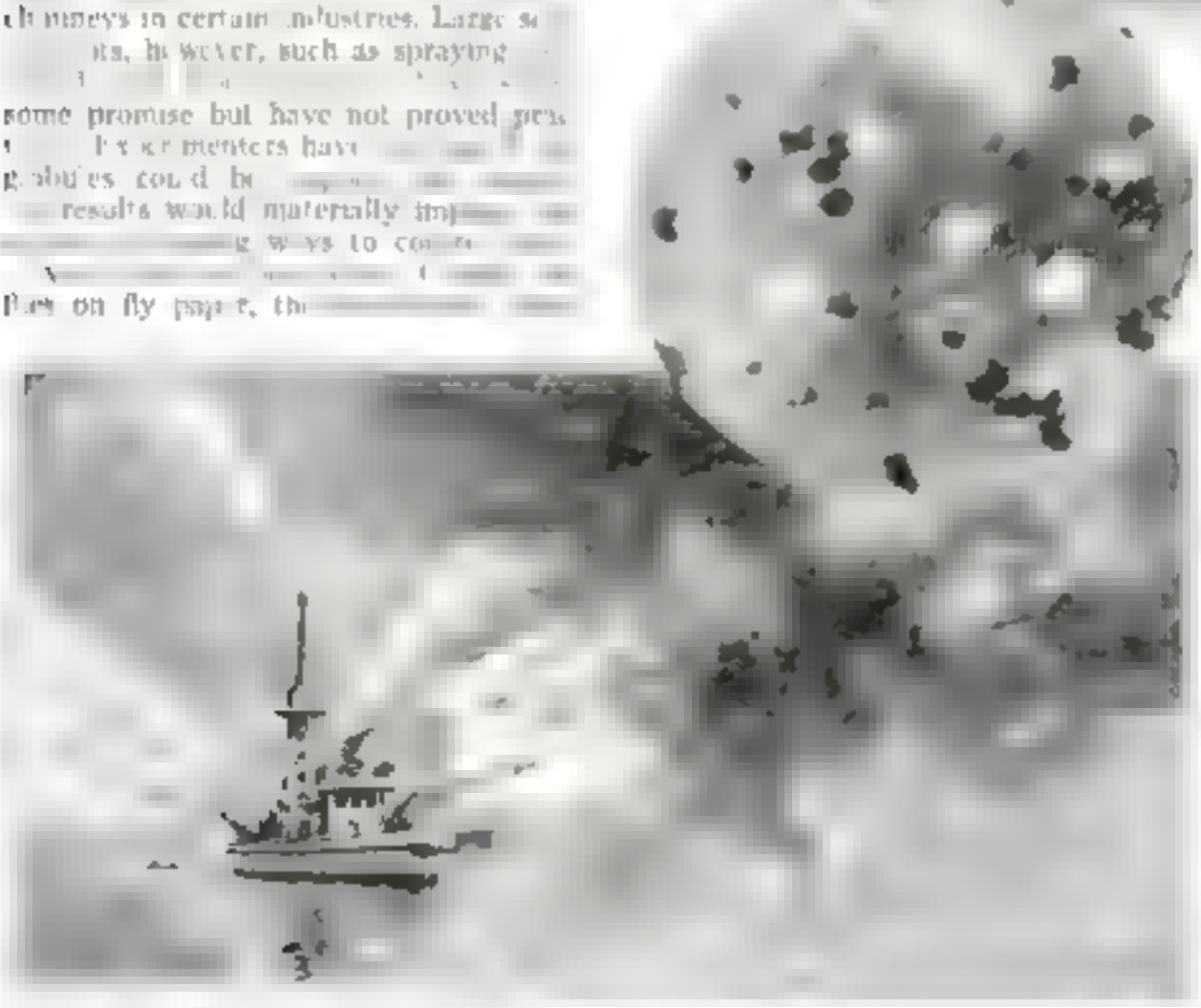


E[illegible]vement, just reported by meteorol[illegible] Massachusetts Institute Techno[illegible]gy, is hailed as a new step towa[illegible]

Al[illegible] previous efforts to c[illegible] menace to shipping and terror of the air [illegible] knowledge of the elements that comprise it. On a laboratory scale it has been found possible to disperse fog artificially with electric devices similar to those that remove [illegible] fumes from chimneys in certain industries. Large scale tests, however, such as spraying [illegible] some promise but have not proved practicable. Experimenters have [illegible] globules could be [illegible] results would materially improve [illegible] ways to control [illegible] flies on fly paper, the [illegible]

[illegible] Varieties of fog have been recognized and classified.

Mounted outdoors, the microscope is supported in a vertical position within a wooden framework. Illumination is provided by a small projector near the base. Its light is reflected upward by a mirror through the glass stage, bearing the particles of fog. For the eyepiece at the top, a camera may be substituted. Fog globules are seen against a scale graduated in divisions two ten-thousandths of an inch apart, permitting their size to be estimated.



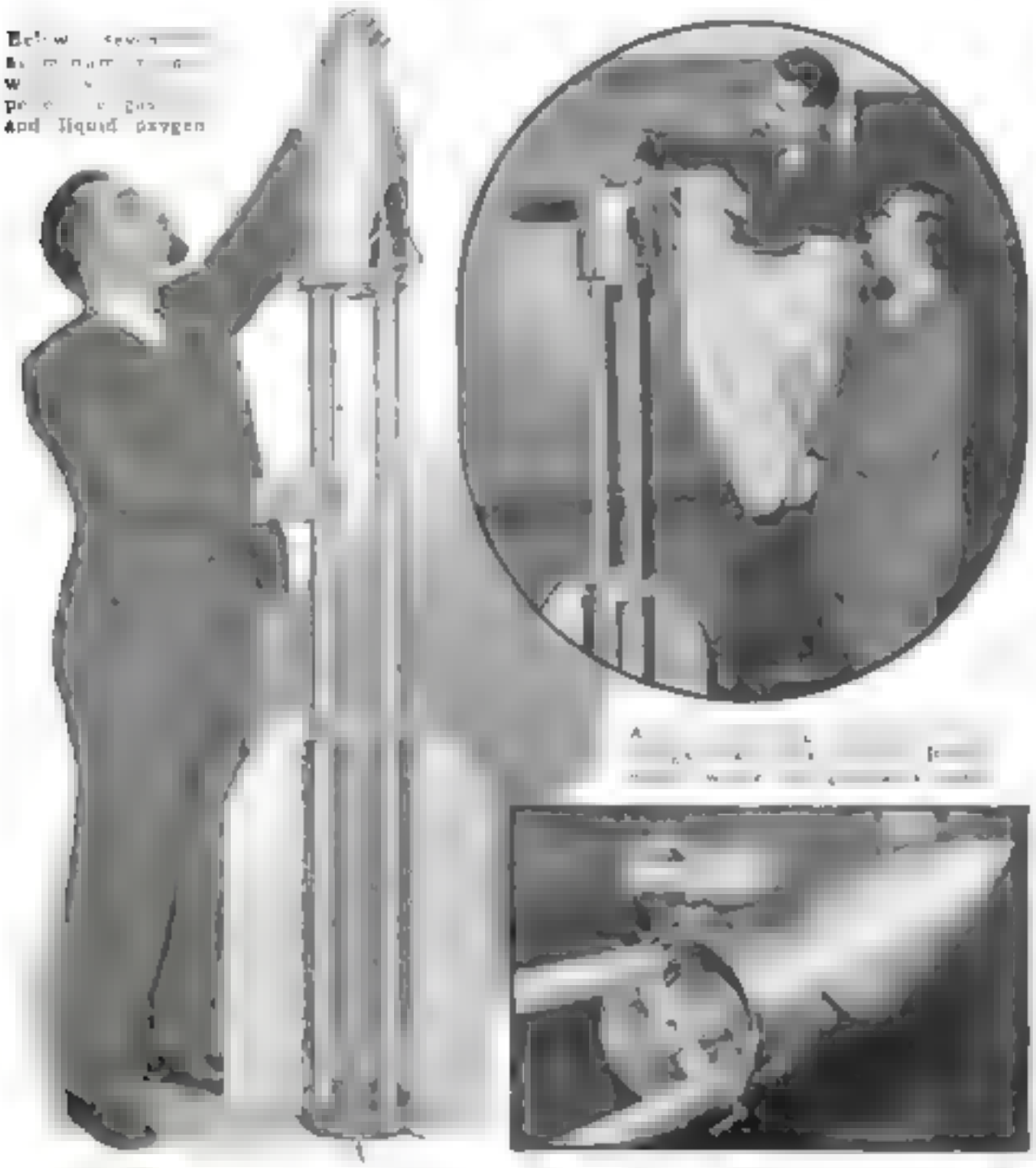
Electrified jets of water hurled into the air by fire boats, have been proposed for clearing summer fog from harbors. This is one of the projects brought nearer realization by new studies of fog

Above, [illegible] a fog globule, as it appears through the microscope. At left, [illegible] one of the first ever taken. The white spots [illegible] droplets and the black [illegible] caused by [illegible] evaporated before [illegible] was taken

Data from these studies may bring to realization many a dream of dispersing fog at will. One way in which this may be [illegible] was suggested not long [illegible] Alexander McAdie, noted meteorologist of the Blue Hill Observatory, [illegible] Mass.

[illegible]rged streams of water from fire boats, he believes, might prove effective against the low-lying fogs of New York Harbor. A fleet of vessels shooting these highly-charged sprays would advance together against a fog bank. Drawn together by the electric charges, the fog particles would condense and fall as rain.

AMERICANS TEST HIGH-FLYING ROCKETS



Below, [illegible] and liquid oxygen

TALK in this country of rocket-driven "space ships" to span the Atlantic, and to leave the earth for jaunts among the stars, moved from fancy toward fact with the recent exhibition of a seven-foot high-altitude rocket in New York City. It was built by the American Interplanetary Society, an organization that plans to conduct in this country rocket experiments similar to those that have already attained considerable success in Germany and that culminated not long ago in the flight of a test rocket six miles high.

The builders intend to shoot the new seven-foot missile of shiny aluminum as high as possible from a sparsely settled locality near Red Hook, N. Y., to test its fuel—a mixture of gasoline and liquid oxygen carried in the two long tubes of its framework. An automatic parachute was devised to return it safely to earth. Following this test, it is expected that larger models will be built. Members of the society predict that within two years, rockets carrying weather-recording instruments fifty miles up will be developed.

USE MILK AT TAKE-OFF TO AVERT AIRSICKNESS

SINCE the discovery that a glass of milk taken before a flight helps to ward off airsickness, air passenger lines have instituted the custom of serving milk to their passengers just before the take-off. Attractive usherettes stand at the doorway of the plane and see that each passenger is provided with a fiber carton of the beverage, packed in sanitary and convenient form.

NEW SUPER-AIRSHIP CHRISTENED *MACON*

WITH work well under way on the U. S. Navy's latest super-airship at Akron, O., the Navy announces that it will be christened the *Macon* in honor of the city of Macon, Ga. Meanwhile plans are under consideration for increasing the size of this air leviathan. Officials estimate that increasing the new ship's volume to over 7,000,000 cubic feet would give her a cruising radius of 11,500 nautical miles, an important military consideration. Moreover, they point out, the feasibility of building so large an airship is shown by the fact that one of 7,000,000-cubic-foot capacity is now under construction in Germany. Sale of another U. S. Navy giant, the dirigible *Los Angeles*, has been proposed to finance the estimated $400,000 cost of the change in plans.

LIGHTS IN PLANE HELP AIR TRAVELERS TALK IN SPITE OF MOTOR'S ROAR

COLORED flashes from miniature [illegible] lamps enable pilot and passenger [illegible] verse' despite the roar of the [illegible] a new system developed in Germany. Panels containing three lamps apiece are mounted on the instrument board in front of each cockpit, together with control buttons. One lamp is red, another green, and a third white. Code signals have been worked out in which certain combinations of colors and numbers flashes stand for designated words a phrases. The communication thus esta lished is practically as rapid and e follow as conversation, it is said.

Below, [illegible] plane

Unusual French Plane for Round-the-World Flight

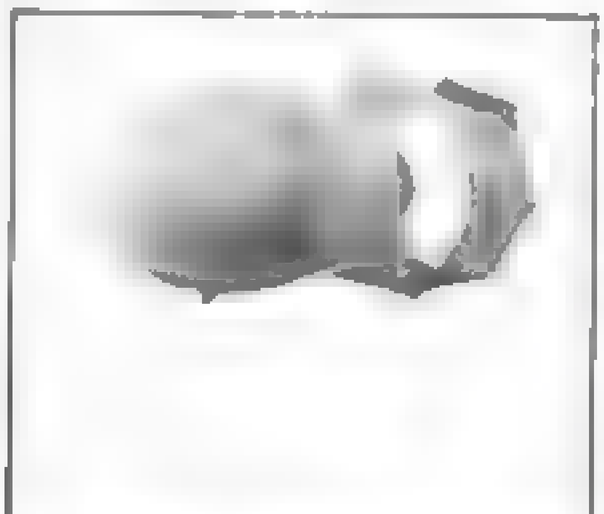
CURVED lines that give the illusion of a sagging body distinguish a new French airplane, combining with its silhouette and striped markings to suggest a giant caterpillar. The odd tri-motored craft has been prepared for a round-the-world flight attempt by two French aviators, and is equipped with a powerful radio. Streamlined throughout, even to the wheel covers, and with special gasoline tanks installed, the craft is expected to make record time on the flight.

NEW TEN-POUND 'CHUTE LOWERS FLYER SAFELY

AN odd "double-deck" parachute, opening to a maximum diameter of only eighteen feet, successfully lowered an airman to earth in a recent test at Alhambra, Calif. Because of its unconventional design, the 'chute is declared to have the advantages of little or no drift, and practically no drag after landing. Packed and ready for use, it weighs only ten pounds. The new parachute was designed by Oswel A. Baker of Alhambra, Calif.

OUTBOARD MOTOR DOCKS SEAPLANE

WHEN airplanes must land in crowded harbors and taxi across the water to the anchorage float, the old-fashioned way of traveling under the power of the spinning propeller involves hazards. In a new way of solving the problem that has appeared, an outboard motor is attached to the plane's tail. Its gentle power safely docks the flying craft, once it has lighted on the water.



BOX KITE KEEPS AIRSHIP FROM TURNING IN WIND

[illegible] ...ns [illegible] ...he [illegible] ...rship can be held [illegible] ...ng [illegible] ...n the wind. To insure this, [illegible] ...les in observation balloons [illegible] ...or the German [illegible] ...re a six- [illegible] ...ing a box kite, [illegible] ...rably more stable [illegible] ...ras

New [illegible] the German [illegible] German balloon tested

Upper eye ornament of an ivory bolas invented on St Lawrence Island. Above, snow goggles worn to protect eyes from glare. At left wooden snow goggles used by Eskimo tribes today

New Discoveries in Arctic Prove

First Eskimos

Were Skilled Inventors

IMAGINE a people as highly cultured for their time, as Americans and Europeans of today lifted bodily from their temperate climate and dropped squarely into the middle of the Arctic. Could they survive? How a whole race accomplished this feat through the resourcefulness of its inventors is a thrilling and hitherto unrevealed page in the world's history.

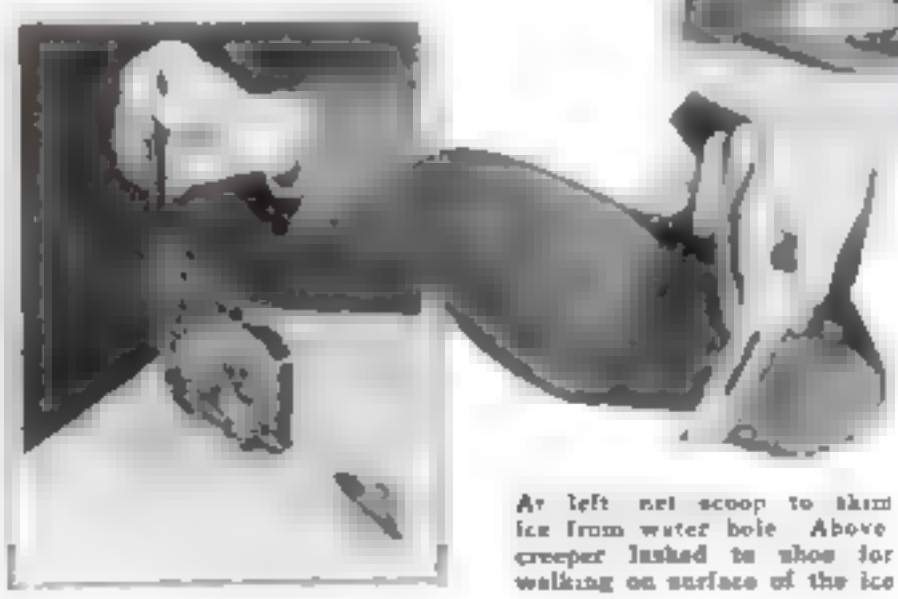
The discovery was made recently by accident. Fortune favored Smithsonian Institution archeologists searching for ancestors of the Eskimos on frozen St Lawrence Island off the northwest coast of Alaska. Their spades uncovered a bed of refuse that yielded an unbroken family tree of the Eskimos for more than 1,000 years.

These early people built homes of timber and stone, sunk below ground for protection against the cold and complete even to floors of flagstones. They devised shoe cleats for walking across the ice, narrow-slitted goggles to protect their eyes against snow blindness, and efficient hunting weapons.

Whence came this strange and cultured race? Piecing its story together, Smithsonian experts suggest it may have started from China. There is evidence that it migrated through Siberia and across the Bering Sea to Alaska. It is possible to imagine the tribe's inventors and engineers gathering in council to devise ways to meet the unaccustomed rigors of the climate, as they must or perish.

That the race triumphed over its surroundings is demonstrated by the presence of its survivors, the modern Eskimos. But their arts and sciences remained a "lost" culture until the Smithsonian discovery. Today the Eskimos themselves do not know the use of many articles found in the ruins—though a few of them, such as the snow goggles, are still in use.

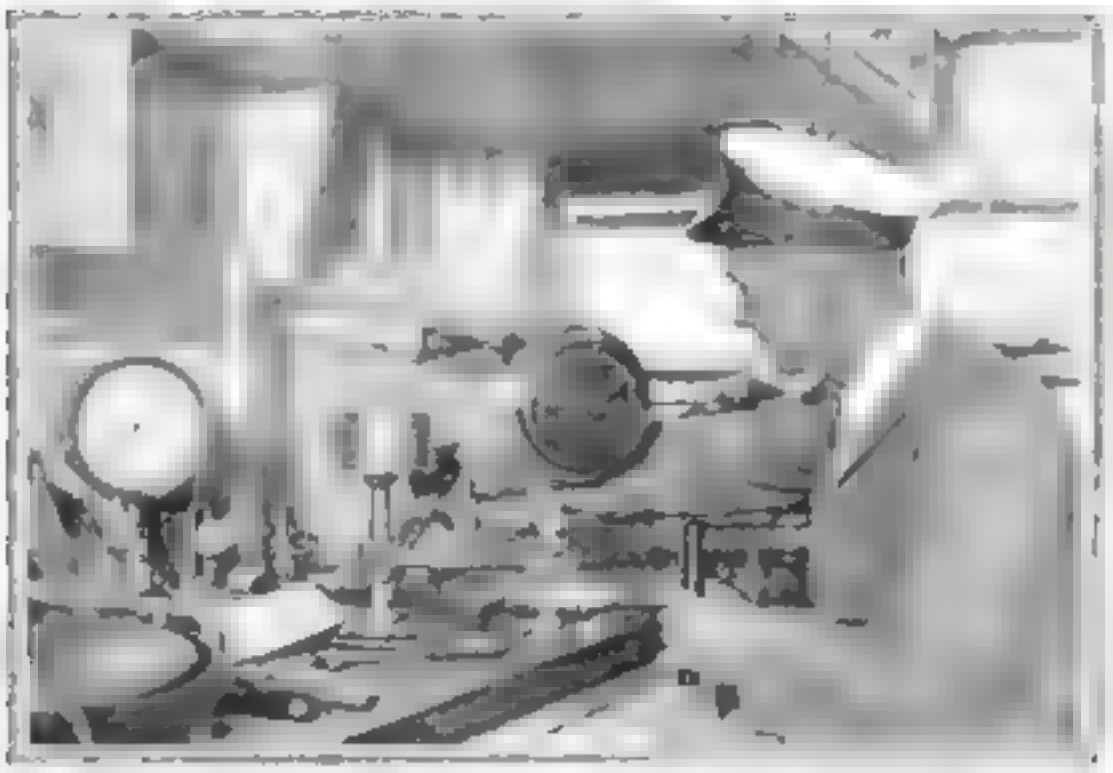
Dried bones were tied together by the old Eskimo warriors and worn to protect body

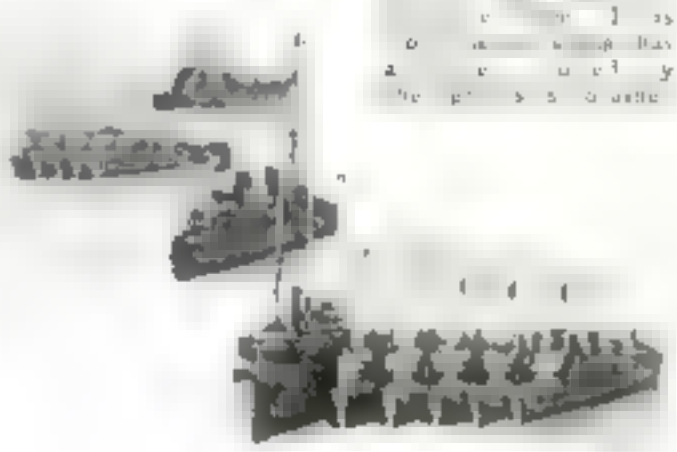


At left net scoop to skim ice from water hole. Above creeper lashed to shoe for walking on surface of the ice

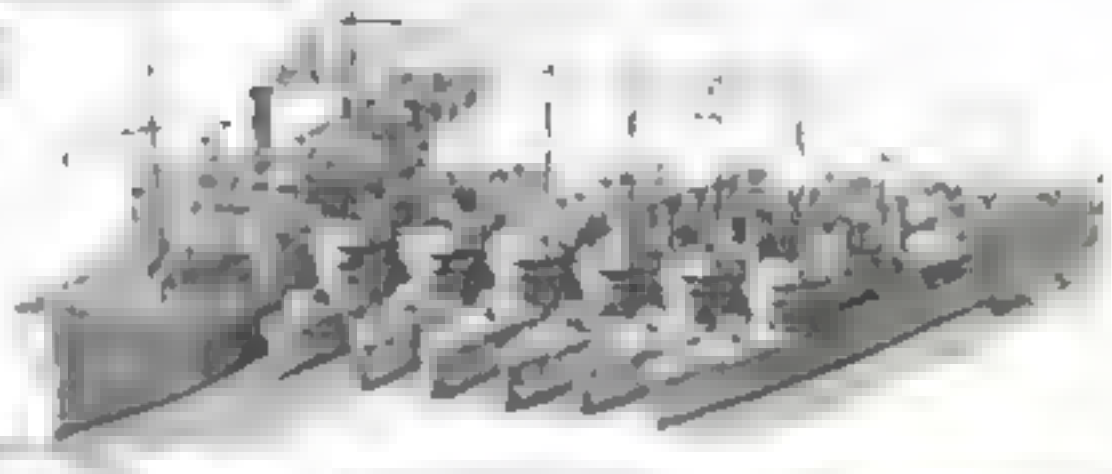
At top, very ancient knives with wooden handles lashed to flint blades. Center bowman's wrist protector and stone ads heads used by earliest Arctic settlers. Above, engraving tool with which harpoon heads were decorated. Handle and lashings of this tool are thought to be more than one thousand years old

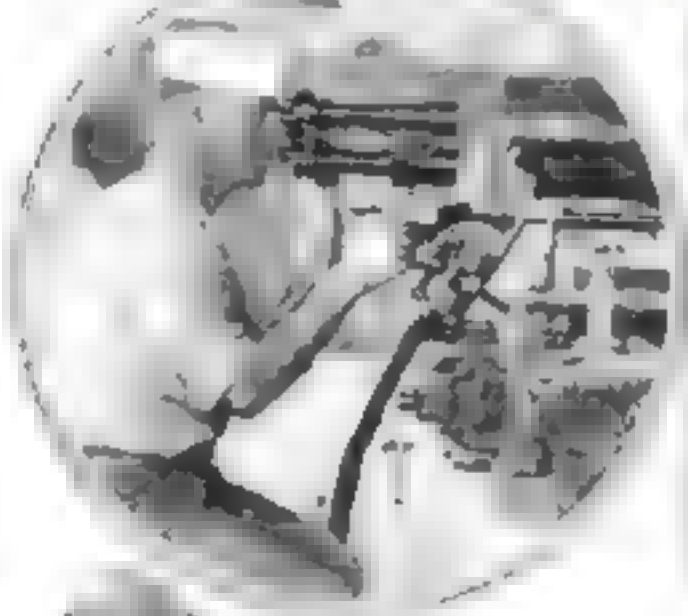
Miracle-Working Ships Keep Navy Fit at Sea





Below, an airplane view of United States





paint. Here is the foundry on the *Melville*

Cut out these pictures along the white lines and you will find it easy to put eight parts together to make two

$10,000 *in* CASH

Here Are Two More Heroes of Science

HAVE you joined the POPULAR SCIENCE MONTHLY gold rush? Thousands have. With a pair of scissors as their only equipment, they are seeking the bonanza right in their own living rooms. The first pay dirt has been struck, and the names of the first group of successful prospectors will be announced soon

All of which is another way of saying that the new, exciting POPULAR SCIENCE MONTHLY Picture Puzzle Cut-Out Contest for $10,000 in cash prizes, which started in the March issue and will end in the August number, is now entering upon its third month, and that you are cordially invited to get in on the winnings. Our novel and delightful contest is sweeping the country, and the judges are kept busy day and night sorting out the stacks of entries

Join now if you haven't done so before On the other hand, if you competed last month or the month before, be sure to continue, for each month's contest is a separate and distinct competition. POPULAR SCIENCE MONTHLY, each of the six months of this "gold rush," will award twenty-nine cash prizes to a total of $1,000. As a crowning feature, seventy-one Grand Prizes, totaling $4,000, will be awarded at the close of the contest. The monthly prizes range from $500 to $10. The Grand Prizes range from $2,000 to $10

At the top of these pages, you see four composite pictures of Heroes of Science and Their Accomplishments Which Heroes of Science are they? And what were Their Accomplishments?

Each of the pictures is divided into four parts, sixteen parts in all. They are arranged so that, when you cut out all of the parts and reassemble HALF OF THEM correctly you will get TWO COMPLETE PICTURES of Heroes of Science, with eight parts left over

To lighten your task, we will give you hints as to the identity of the Heroes of Science and the accomplishments for which they are famous. If you use our hints, you will find the solving of these puzzles an easy and entertaining job.

The monthly prizes, totaling $1,000, will be awarded to contestants who submit the two correct pictures, assemble and mount them in the neatest and most skilful manner and state the name and accomplishment of each of the two Heroes of Science in twenty words or less

Please remember this Keep the eight parts you have left after sending in your two complete pictures to compete for the monthly prizes. These left-over cuttings will give you TWELVE ADDITIONAL COMPLETE PICTURES of Heroes of Science, provided you have kept the unused cuttings from the beginning of the contest. The left-overs must be kept by the contestants throughout the six months of the contest, and the additional TWELVE COMPLETE pictures must not be sent in until the close of the contest, when the Grand Prizes will be awarded. Submit only TWO COMPLETE PICTURES, in which no left-over cuttings are used, in competing for the monthly prizes. For instance, the TWO COMPLETE PICTURES you send us this month must be assembled from the cuttings numbered from 33 to 48 inclusive

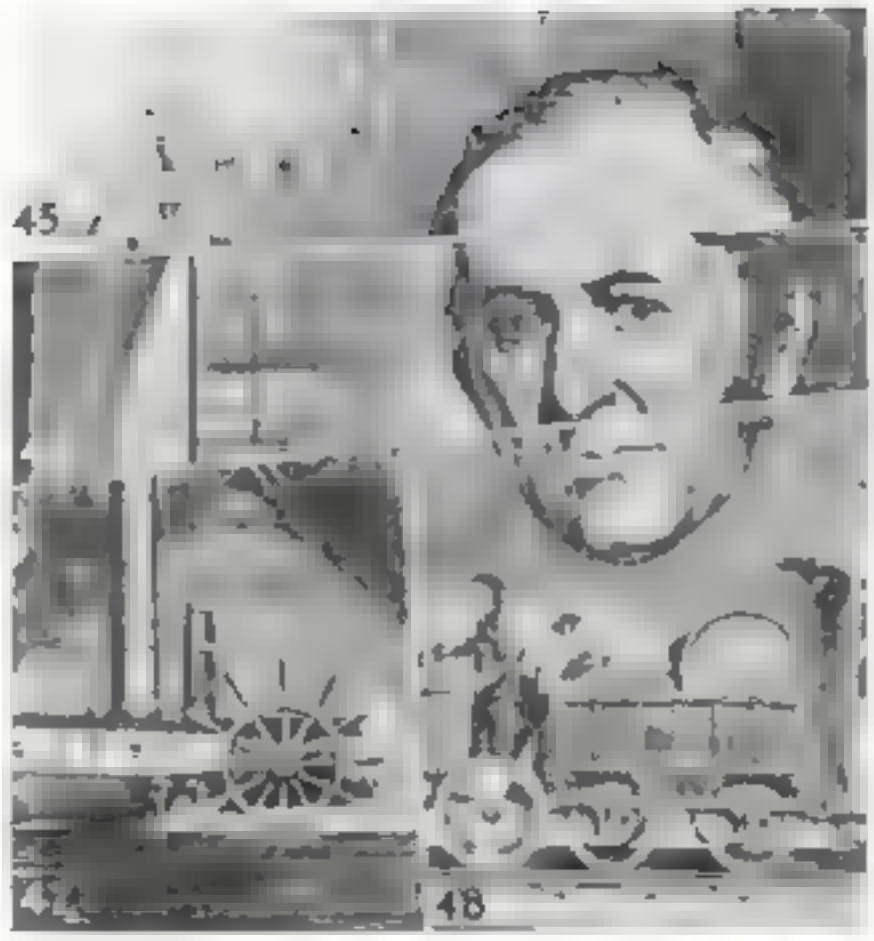
You need not be a subscriber or regular reader of POPULAR SCIENCE MONTHLY to compete in this contest, nor is it necessary to buy the magazine. You are permitted to borrow a copy from a friend or see the current or the two previous issues at the Public Library or any office of POPULAR SCIENCE MONTHLY and copy or trace the pictures You are allowed to get all the help you need from neighbors, friends, or relatives, and you may submit as many entries in each contest as you wish. Do not start work on this month's pictures before you have read the rules of the contest on the opposite page

MONTHLY PRIZES

First Prize	$ 500
Second Prize	100
Third Prize	50
Six Prizes, $25 Each	150
Twenty prizes, $10 Each	200
Total	$1,000

GRAND PRIZES

First Prize	$2,000
Second Prize	500
Third Prize	200
Three Prizes, $100 Each	300
Five Prizes, $50 Each	250
Ten Prizes, $25 Each	250
Fifty Prizes, $10 Each	500
Total	$4,000

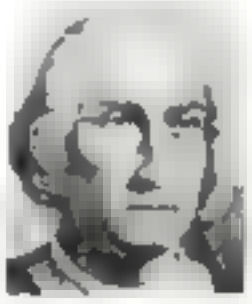


pictures. Eight parts will be left over Save these carefully to use in making pictures for the Grand Prize Contest

PRIZES FOR SOLVING NEW AND EASY PICTURE PUZZLES

Marconi, world famous developer of far-reaching wireless

Whitney, whose inventive genius made cotton king



Columbus, explorer and navigator who found a new world

Stephenson, who led the world in developing locomotive

Henry Ford, pioneer in mass production of low-priced autos

Pasteur, creator of bacteriology and father of antiseptics

The Men Whose Pictures Can Be Completed Are in Above Group

Rules of the Contest . . . Read Carefully

1. Each month, for six months, beginning with March POPULAR SCIENCE MONTHLY is printing four composite pictures of Heroes of Science and Their Accomplishments. Each set of pictures, when cut apart and assembled correctly, will make two complete pictures with eight parts left over.

2. The pictures must be pasted together The monthly prizes will be awarded to those contestants who assemble the pictures correctly and in the neatest and most skillful manner. Each of the two complete pictures must be accompanied by twenty words or less, identifying the Hero of Science and his accomplishment

3. Answers to each monthly contest must be mailed or delivered to the offices of POPULAR SCIENCE MONTHLY not later than the last day of the month following the date of publication of the magazine in which the pictures appear. Thus, solutions of the puzzle in this month's issue must be mailed or delivered not later than May 31

4. At the close of the six monthly contests, there will be a final contest for Grand Prizes. To compete for these, contestants must carefully save the cuttings left over from the monthly contests. These left-over cuttings, during the six months, will produce twelve additional complete pictures of Heroes of Science and Their Accomplishments, if assembled in the correct way. These additional pictures must not be submitted during the progress of the monthly contests but at their close. Entries for the Grand Prize contest must be mailed or delivered not later than the last day of the month following the date of publication of the magazine in which the pictures for the last monthly contest appear. This will be the August issue, published July 2. Entries for the Grand Prize contest, therefore, must be mailed or delivered not later than August 31

5. To receive consideration for the Grand Prizes, contestants must submit not less than twelve additional complete pictures

6. Grand prizes will be awarded to those contestants who assemble the twelve additional pictures correctly and put them together in the neatest and most skillful manner. Each of the twelve pictures must be accompanied by twenty words or less, identifying the Hero of Science and his accomplishment

7. In case of ties each tying contestant will be awarded the prize tied for. This rule will be observed in the monthly contests as well as in the Grand Prize contest.

8. All entries should be addressed to the Heroes of Science Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York City. Name and address of the entrant must be written plainly on each page of the entry. Entries with insufficient postage will not be accepted. The publishers cannot be responsible for delay, loss, or non-delivery of entries. No contribution entered in this contest will be acknowledged and none will be returned. No letters of inquiry regarding points covered in the rules can be answered.

9. There is no entry fee. You need not buy POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend and trace or copy the pictures, or you can examine a copy of the magazine at any office of POPULAR SCIENCE MONTHLY or at the public libraries free of charge.

10. Each contest is open to everybody, everywhere, except employes of POPULAR SCIENCE MONTHLY and the Popular Science Institute and their families. The officials of the Popular Science Institute will act as judges and their decision will be final.

HOW MEDICAL

Murder Secrets *in*

OLD OR NEW SCARS? Medical experts are now able to tell whether scars are the result of recent or old wounds. In this picture marks on the neck are photographed to determine their age

By EDWIN W. TEALE

NOON-HOUR crowds in a Massachusetts manufacturing town scattered as a police car charged down the main street, swung around a corner, and stopped before the house of a factory superintendent.

Inside, the detectives found the superintendent's wife dead on the floor of her bedroom. A pearl-handled revolver, containing two empty shells, lay near her right hand. Stuck in the mirror of a dresser was a suicide note in the woman's handwriting addressed to her husband. The superintendent declared his wife had been ill when he left for work in the morning. On his return at noon, he had found her shot to death by her own hand. The case seemed a simple suicide.

The next day an elderly woman appeared at police headquarters and told an amazing story. She said she was the dead woman's mother and lived in Boston. The day before the tragedy her daughter had appeared at her house, after a violent quarrel with her husband over his attentions to another woman. The daughter had left a note saying she was going to commit suicide, and then had taken a train for her mother's home in Boston. That evening, her mother persuaded her to return to her husband and she had called him on the long-distance telephone and arranged for him to meet her at the station. The next day the mother learned of her daughter's death and came to tell her story. She was positive the husband had killed her daughter, using the suicide note as a screen for his crime.

Detectives scurried out to check up on the story. They found the dead woman had made the trip to Boston and that there had been quarrels over the superintendent's infatuation for another woman. As to direct evidence of murder, there was none. Then, one of the most astonishing bits of proof ever used to expose an infamous crime was unearthed by a crack medical sleuth of the coroner's office.

In his post-mortem examination of the body he found one bullet had entered the stomach just below the breastbone, the other passing through the heart. The wound in the stomach had produced considerable hemorrhage, but the one in the heart had resulted in practically no leakage of blood. The second bullet had penetrated this organ *after it had stopped beating!*

The woman's death could have only one explanation—murder. No one can shoot himself after his heart has stopped. So police fine-combed the city and the house for clues. Additional evidence was piled up around the guilty man, breaking down his perfectly planned defense. Before he paid for his crime in the electric chair, he confessed to the murder.

Such dramatic discoveries, accomplished through study and knowledge of the human body, form a thrilling chapter in the story of scientific crime detection. In gathering material for this series of articles from veteran homicide sleuths in all parts of the country, I learned of scores of instances in which some infallible clue found in the body of a victim or in the wound of a suspect tripped up a desperate criminal.

How long has a victim been dead? How old is a scar? Is a stain blood? Did a piece of bone come from a human skeleton? Was a sudden death caused by poison? Was it suicide or murder? In answering these and a host of other vital questions, the medical expert solves mysterious crimes of violence.

A few years ago a half-million-dollar jewel robbery in an eastern state ended in a spine-tingling climax through sensational testimony by a medical expert. Late at night, a retired banker returned to his apartment to find his wife unconscious with bed-sheeting knotted about her head. The butler, the only other person in the house that night, was found moaning in the closet of his room, his throat scratched and bruised and the front of his pajamas red with blood. Two long gashes extended from his left arm-pit halfway across his chest.

He told a vivid story of being awakened from a sound sleep by fingers sliding across his throat, of opening his eyes and seeing the greenish glow of a radium

IDENTIFYING TEETH

EXPERTS FIND

Scars *and* Wounds

wrist watch, of being choked and slashed in the struggle with his assailant and of losing consciousness and coming to in the closet. He had not seen the mysterious intruder and the only clue he could offer was the radium watch.

When a wound expert from headquarters examined the cuts, he discovered a peculiar thing. If you slash a knife across the curved surface of an apple, the blade sinks deepest at the mid-point of the cut. In these wounds, across the curved surface of the man's chest, the depth remained the same from beginning to end. They had been carefully cut, penetrating just below the skin, and could not have been made in a violent struggle.

Under a bombardment of questioning the servant broke down and confessed he was an accomplice of a gang of gem thieves. He had helped in the robbery, sheets having been tied over the woman's head so she would not recognize him, and then he had produced the fabricated wounds to avert suspicion. On information he gave, detectives swooped down on a liner leaving for Europe. In a last-minute arrest of the gang, they recovered the loot. The revelation of the medical expert had made this fast-moving work of the police possible.

One curious thing about self-inflicted cuts and burns I learned is that the criminal is practically never satisfied with one wound. At the Scientific Crime Detection Laboratory, in Chicago, I was told there are almost always two or more, parallel or crossing each other. When the suspect is right-handed, these wounds are invariably on the outside of the left arm or on the left shoulder; when left-handed, on the right arm or shoulder. Parallel or crossing burns in these places are also considered suspicious.

After a fatal shooting, an examination of the victim's wounds is often essential to reconstructing the action of the murderer. When a bullet has passed through a body it is important to know from which side and at what angle it came. A mysterious "sniper" murder was solved a few weeks ago in New York by finding the angle at which a bullet passed through the body of a woman, who was sitting near a window when she was shot. The line of the bullet's flight was carried to the top floor of a boarding house, half a block away. There, sleuths uncovered clues that put them on the trail of the killer.

Usually, the side from which a bullet entered a body can be determined instantly by the shape of the wound. The wound of entrance is round or oval, the wound of exit usually slit-like. Such wounds, I learned, rarely give an exact idea of the size and shape of the weapon used.

In a fiendish series of slayings in Austria, some years ago, three women on successive nights were found stabbed to death. Above the heart of each was a peculiar wound, shaped like a cross. When the maniac murderer was run to earth it was found that he had used a square, blunt-nosed file for a dagger. Instead of leaving a square wound, as would be expected, the implement had produced one cross shaped.

Whether the muscles are tense or relaxed when a wound is received has a great deal to do with its shape. A California detective told me of one case in which a death wound was a peculiar long thin slit in the chest muscles above the heart. It was thought an unusually wide and thin dagger must have been used. The defense proved the only weapon available to the suspect at the time was an ice-pick. However, a medical examiner showed that the chest muscles of the victim had been tense and knotted when the blow was struck. When they relaxed in death, the round hole was stretched into the long, thin one that puzzled the police.

In some European crime laboratories, casts are made of fatal wounds for permanent record through use of moulage, a plastic colloidal substance. Several American cities, notably Chicago, Ill., and Pasadena, Calif., have tested moulage as an aid to crime detection.

When wounds are fatal, one of the first questions that has to be answered is: How long has the victim been dead? Only the medically-trained expert can give an accurate estimate. By making special

IS IT HUMAN BLOOD? In the laboratory medical experts are engaged in making blood tests. Blood can now not only be identified as human but it can be classified in one of four big groups. In upper circle, microscopic slide of aggregated blood and in lower circle, slide of unaggregated blood specimen.

At left above, a human hand molded of moulage. Note how exactly it copies the actual hand.

studies and electrical and chemical tests, he comes to his conclusions. During the first few hours after death, an eastern expert told me, the muscles react to electrical stimulation. Also, the pupils of the eyes expand when the drug atropine is applied. Later, neither effect takes place.

The fall of temperature of the body also gives a fairly accurate record for from four to thirty hours after death. A rule of thumb method, applied by medical examiners in cases in which victims are not found until some time after the murder, is that a body decomposes as much in one week in open air as it does in two weeks in water or during six weeks under the ground.

The solution of an eastern bombing case illustrates the way in which clues found in wounds that are not mortal may come to the aid of the medically-trained criminologist. A bomb buried at a political parade exploded prematurely, killing three people. The thrower of the bomb was injured in one arm by a flying fragment, but made his escape.

Later a suspect with a bandaged cut on his left forearm was taken into custody. On the day of the crime, he claimed, he had been in another city, and his injury was caused by falling on a piece of broken glass. A medical examiner studied the wound. Encircling the cut, he found a fine line of brilliant yellow. The wounds of all the three victims had shown this same mysterious yellow border—identified as the stain of picric acid, a constituent of the explosive used in the bomb.

DR. CHARLES NORRIS, Medical Examiner for New York City, once told me of another strange case, in which a "Lone Wolf" burglar was convicted through the careful work of a police doctor. As this thug leaped from a store window after a robbery, a night watchman emptied a shotgun at him and was sure he struck him in the left hand. A week later, a suspect was picked up in a neighboring city. No wounds were found on his left hand, but police noticed it was covered with an elaborate tattoo design. At headquarters, the hand was X-rayed and seventeen pellets of lead were revealed within the flesh. The entrance of each wound had been artistically incorporated in the design by some tattoo artist of the underworld. They might easily have escaped detection but for the searching rays of the laboratory.

Frequently, the medical sleuth has recourse to the X-ray in his work. Often criminals change identifying scars by cutting, cauterizing or tattooing. Then, X-rays are called on to show whether there is a bullet embedded beneath the suspected scar or whether the bone has been chipped by lead which has been extracted.

HOW SLEUTHS DISCOVER BLOODSTAINS

Microscopic spectacles are used, as above, in examining clothing worn by suspects in an effort to find bloodstains. This leaves the hands free to make the benzidine and hydrogen peroxide test which instantly shows blue-green streaks if the stain examined is blood.

However, this work must be done painstakingly to avoid errors. There is one case on record in which a thief was shot in the right leg as he made his escape. Later a suspect with a scar on his leg was placed under the X-ray. The resulting picture showed a dark spot, about the size of a bullet, near the bone. It was proved, however, that a short time before the accused man had been cured of sinus trouble by an injection of bismuth and iodoform paste. A collection of this foreign material in the tissue had produced the dark, bullet-like spot which the X-ray plate showed.

Often, the identification of a scar is the only thing that prevents a desperate criminal from slipping through the hands of the police. When a wanted man of the underworld is known to have been injured in a certain way at a certain time, suspects are carefully examined for the kind of scar that would result from such an injury. Often the decision of the medical examiner hangs upon the question: How old is the scar?

IN DECIDING, the expert first of all studies the color. All scars, I am told, except very superficial ones, pass through three distinct stages. Up to from a few weeks to two months, they are bright red, soft and sensitive. From two to six months, they are brown or copper-colored, free from contractions or corrugations, and soft to the touch. From six months on, the scars are white, glistening, contracted, and tough. By means of this "color catalogue" the detective gets his first clue as to the age of a wound that has healed.

I watched one expert making an examination of an old, faint scar which had resulted from a knife-wound, twenty years before. To bring it out more clearly, he applied hot towels to the spot, thus making the surrounding skin red so the white scar stood out in sharp contrast.

Probably the most extraordinary instance of a scar identifying a victim occurred in the notorious Crippen case in England. This sinister poisoner had buried his wife's body in lime beneath bricks in his cellar. When police uncovered the human remains, it was thought identification would be impossible. Then, one fragment of skin was found to contain a scar. It was submitted to a famous surgeon who identified it as the result of a peculiar operation, one that was known to have been performed upon the missing wife of the murderer.

A new weapon for tracking down a modern poisoner has been recently put at the command of the scientific detective. At the Pacini Laboratories, in Chicago, I was shown an apparatus that combines the use of ultra-violet rays and the spectroscope in determining the presence of mercury. By a study of the color bands seen through the spectroscope, the expert can determine instantly whether the poison in a body is in medicinal or deadly quantities.

RECENTLY, in Germany, the fact that arsenic glows or fluoresces, with a characteristic color when struck by ultra-violet rays was accepted in court as a new test for the presence of this deadly powder. A microscope, equipped with an electrically heated stage, is another recent innovation. It enables the medical criminologist to discover strychnine and other alkaloids by determining the melting point of suspicious particles.

In a murder case tried in Pennsylvania some years ago, a microscopic examination of poison crystals led to a dramatic climax. Several grains of arsenic were found in the stomach of a woman who had died under suspicious circumstances. Her husband, accused of her murder, maintained she had been taking a trituration of arsenic to improve her complexion. This drug was found in the house. A scientific sleuth, peering through his high-powered microscope, revealed that while the poison in the complexion prescription was finely ground, *the arsenic in the stomach was in distinct crystals.*

The murderer, knowing his wife was taking small doses of the poison, plotted her death by a larger dose of the same deadly drug. But, he failed to take into account the powers of the microscope.

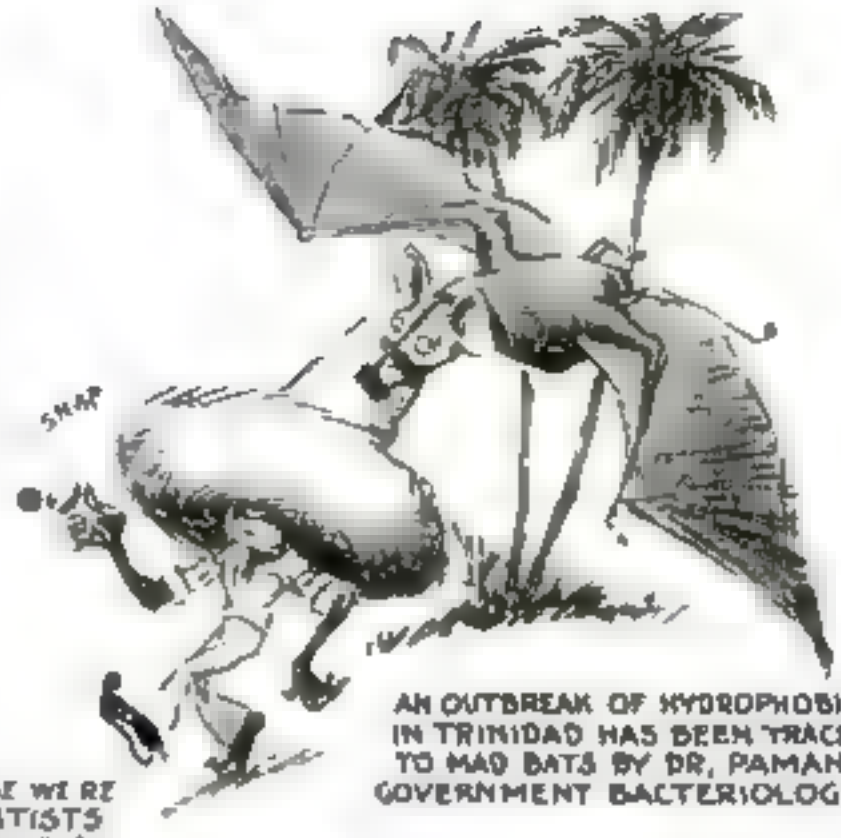
Even when only the skeleton of a poison victim remains, the modern methods of scientific crime detection often can prove the cause of death was arsenic or mercury. The remnants of such fatal metallic poisons can be extracted from the bones, themselves.

In fact, studying the bones of a victim is a frequent means by which the medical detective discovers clues to long-ago crimes in which years pass before a murdered person is *(Continued on page 128)*

How Trained Scientists with Blood Tests, Invisible Light, Microscopes, and Chemicals Aid the Police in Trailing Desperate Killers and Crooks

SCIENTIFICKS

...OUR ARTIST VIEWS THE STRANGE AND UNUSUAL FACTS DISCLOSED BY LEADING AUTHORITIES IN THE LAST MONTH



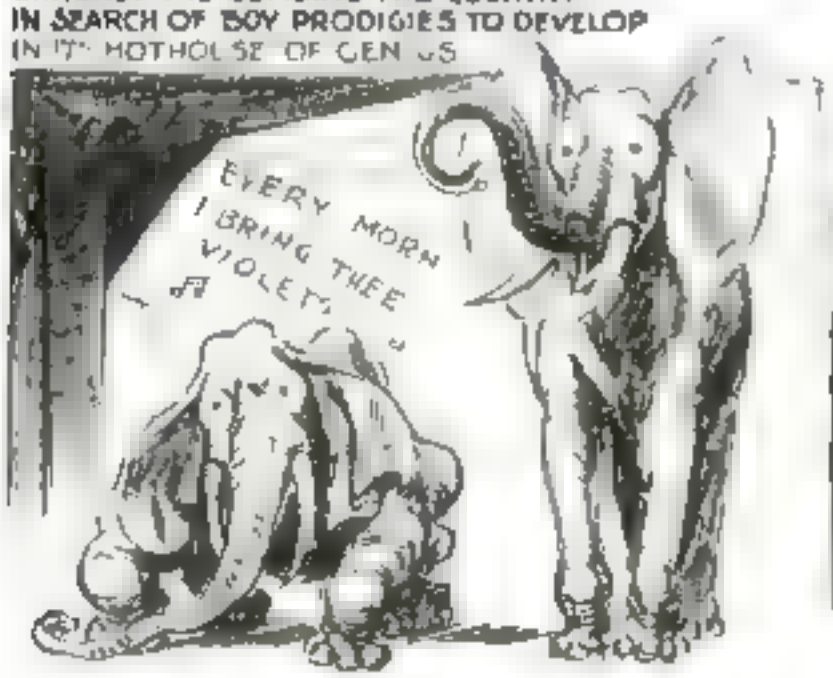
AN OUTBREAK OF HYDROPHOBIA IN TRINIDAD HAS BEEN TRACED TO MAD BATS BY DR. PAMAN, GOVERNMENT BACTERIOLOGIST

DR IRVING LANGMUIR SAYS THE WORK THAT WON HIM POPULAR SCIENCE MONTHLY'S $10,000 AWARD FOR SCIENTIFIC ACHIEVEMENT WAS DONE FOR FUN

NOW THIS LITTLE DOUBLE JOINTED, TRIPLE EXPANSION MULTI ARTICULATED THREE SPEEDS FORWARD TWO REVERSE FREE WHEELING MULTI DISK AUTOMATIC CLUTCH STANDARD SHIFT ALTERNATING CURRENT FLAT IRON WILL DO

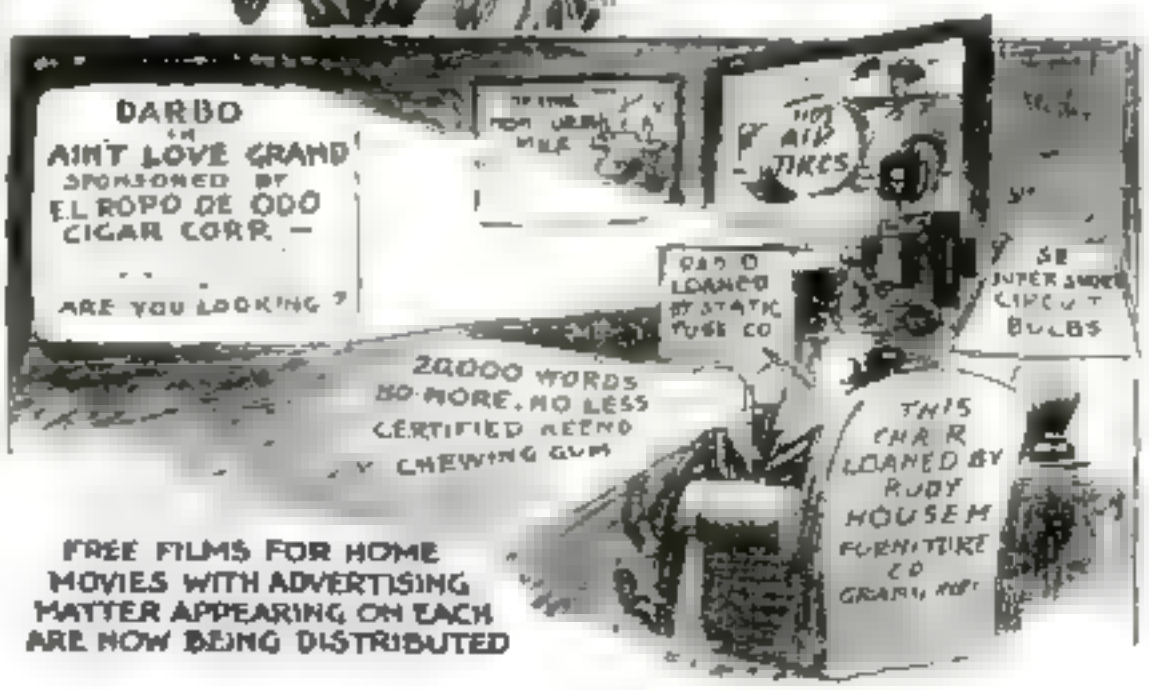
HOLLYWOOD MOVIE PRODUCERS HAVE BANNED ACTORS WITH GOLD TEETH BECAUSE LIGHT REFLECTED FROM THEM RUINS THE FILM

NORTHWESTERN UNIVERSITY IS COMBING THE COUNTRY IN SEARCH OF BOY PRODIGIES TO DEVELOP IN IT'S HOTHOUSE OF GENIUS



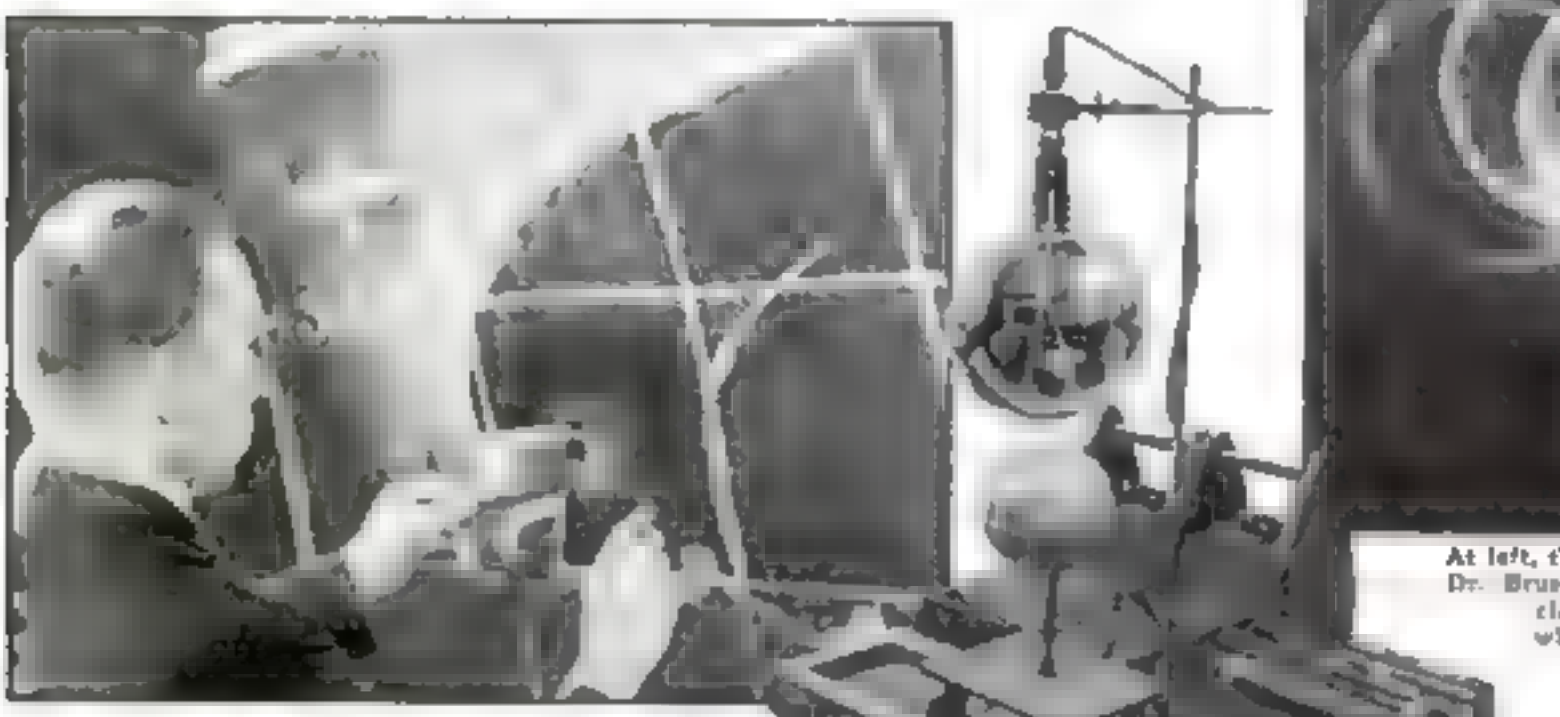
ULTRA-VIOLET RAYS HAVE CURED 200 ANIMALS OF RICKETS IN THE HIGHLAND PARK ZOO PITTSBURGH PA.

DR ALFRED FLINN DIRECTOR OF THE ENGINEERING FOUNDATION OF NEW YORK CITY SAYS THE WORLD NEEDS A NEW UNIVERSAL LANGUAGE FOR SCIENCE, BUSINESS AND POLITICS



FREE FILMS FOR HOME MOVIES WITH ADVERTISING MATTER APPEARING ON EACH ARE NOW BEING DISTRIBUTED

STUDY OF NORTHERN LIGHTS LEADS TO INVENTION OF NEW COMPASS



Dr. E. Brueche, in his laboratory in Germany, plotting the height of a display of northern lights from two photos taken from two observation stations

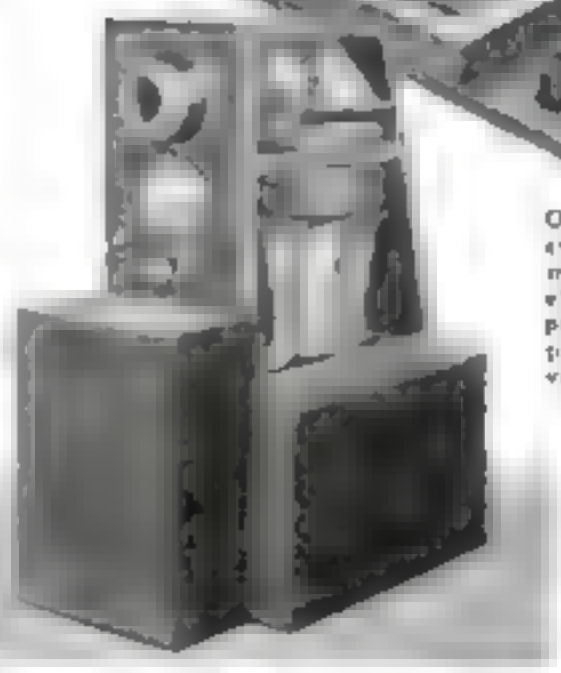
At left, the apparatus with which Dr. Brueche produced the artificial aurora, a picture of which is reproduced above

How research on a seemingly abstract subject often results in a practical discovery of great value was illustrated in Germany the other day when the experiments of Dr. E. Brueche, noted electrical engineer, in producing artificial northern lights, led to the invention of a valuable new type of compass.

Current theory tentatively explains the aurora borealis, or northern lights, as the result of collision between streams of electrified particles called electrons, shot out from the sun, with the thin upper atmosphere of the earth. By providing a cathode ray tube as a source of a stream of electrons, a near-vacuum for the earth's upper atmosphere, and a small magnetized globe to represent the earth, Dr. Brueche was able to produce a miniature artificial aurora.

This experiment, performed before with crude apparatus, yielded, in Dr. Brueche's hands, new data. It proved possible to determine complicated paths of certain types of auroras that could not be foreseen from theory.

Noting how the beam of electrons was swung by a weak magnetic field, Dr. Brueche conceived the invention of an "electron compass" for aircraft. In this new instrument the customary magnetic needle is replaced by an electron beam free from the effects of inertia and gravity, and instantly responsive to a change in direction.



Out of the northern light experiments came the electron compass which may prove of great value to airmen

DINOSAUR HAD BONE BALL ON TAIL

Like a convict dragging a heavy ball at the end of a chain must have appeared a remarkable dinosaur whose bones were discovered the other day in Montana. At the end of his tail he carried a ball of bony material that weighed fifty pounds, shown in the photo above. Scientists first suggested that the animal might have used this extraordinary appendage as a weapon by swinging its tail. Dr. Charles W. Gilmore of the Smithsonian Institution declares it was too heavy even for a dinosaur to lift, so its purpose remains a mystery.

CONVERTER TURNS YOUR RADIO SET INTO SUPERHETERODYNE

From five to twenty new stations are brought within the range of an ordinary tuned radio-frequency receiver by a new attachment that converts it into a superheterodyne. Serving also as a smoking stand, the converter may be placed anywhere in the room at the end of its thirty-foot cord. Its user may then bring in any desired station without moving from his chair. Inside the attachment are two tubes that supplement those of the standard radio set and increase its selectivity. It can also be used as a remote control unit for a superheterodyne.

Smoking stand has two-tube converter that turns radio-frequency set to superheterodyne

AIM TO CHANGE Great Salt Lake INTO FRESH WATER

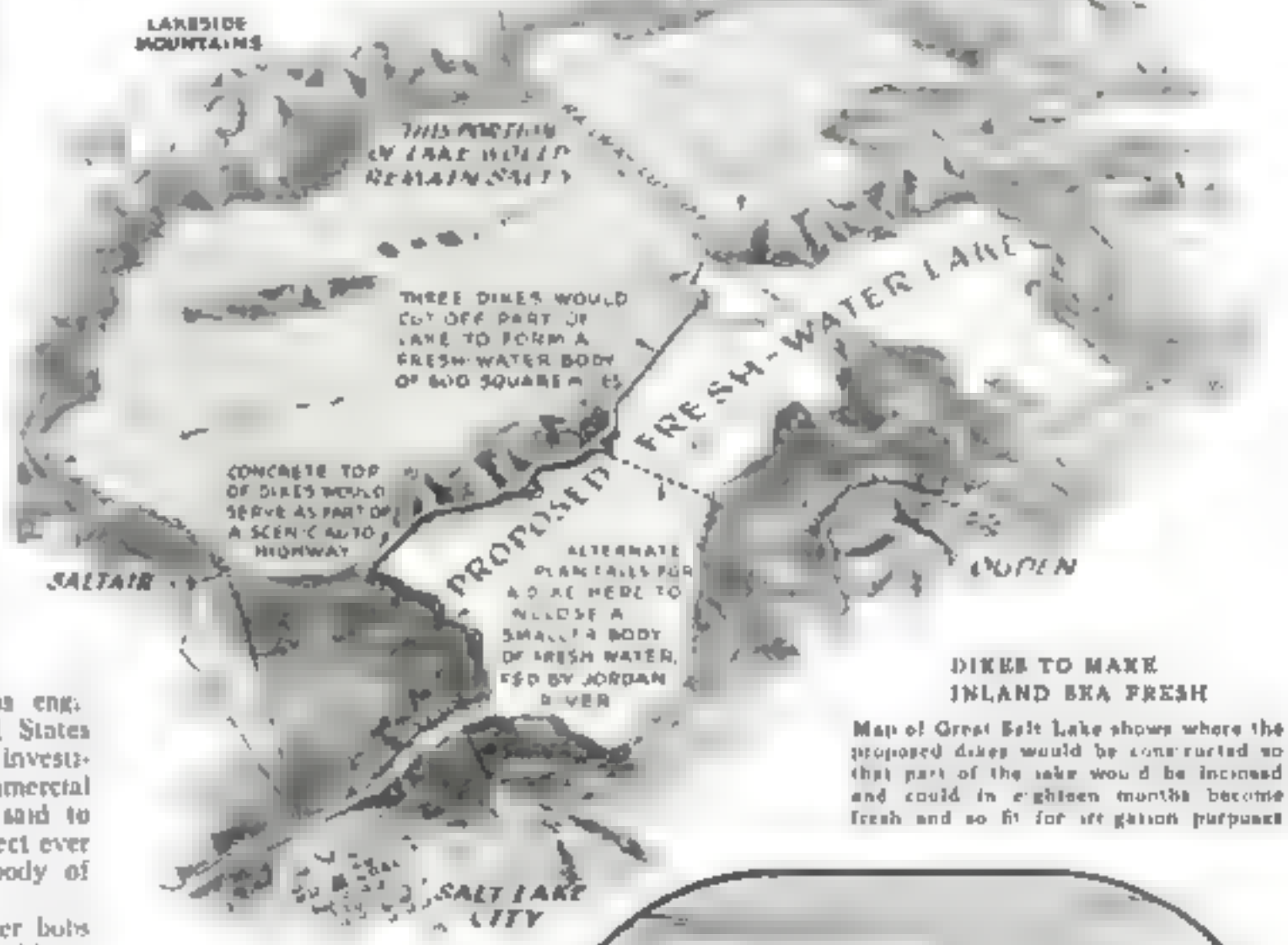
Vast beds of salt lie on the shores of Great Salt Lake are plowed up and carted away to be purified and sold. For at least 25,000 years salt has been accumulating here

CAN the waters of America's Great Salt Lake be turned fresh? Soon the world will know the answer to that question. For the startling proposal has been made to fence off a 600-square-mile area of the Great Salt Lake of Utah with dikes and turn its contents to fresh water for irrigation and water supply.

Test borings have shown a favorable foundation for the miles of dikes that would be needed to accomplish this engineering feat. Now United States Government engineers are investigating the cost and commercial practicability of what is said to be the most extensive project ever proposed for turning a body of salt water to fresh.

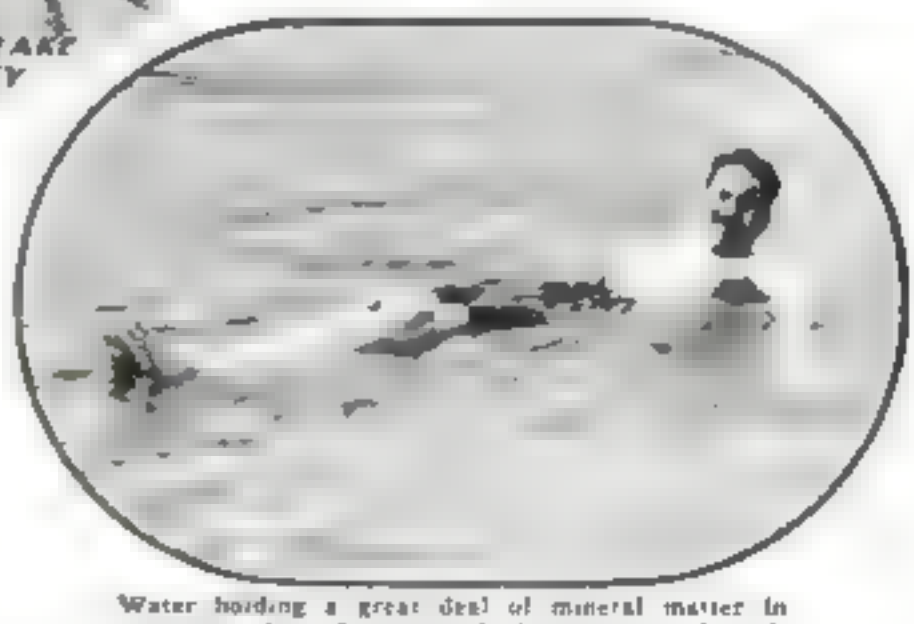
So buoyant that a bather bobs about in it like a cork, unable to sink, and so vast that it covers an area half again as large as the state of Rhode Island, the Great Salt Lake has no known outlet. Hence the waters of the rivers that feed the shallow basin have no escape save by evaporation. That is the secret of the lake's saltiness. Every three and a half years, it is estimated, the sun's heat evaporates from the lake as much water as it now contains. Meanwhile minerals in the water, remaining in solution, have gradually accumulated during the thousands of years of the lake's existence. Today it holds 400,000,000 tons of dissolved salt, and this natural brine tank has long since become one of America's outstanding geological curiosities.

The only ones who appreciate nature's little joke are the proprietors of the lake's tourist resorts and the owners of the enterprising concerns that harvest the salt from the white deposits that border the shore, purifying and marketing it. A parched desert stretches beyond, unproductive for lack of water. It is said that the French engineer De Lesseps, who built the Suez Canal and started the Panama Canal, visioned this desert dotted with farms and blossoms as a result of freshening the water of the Salt Lake for irrigation purposes.



DIKES TO MAKE INLAND SEA FRESH

Map of Great Salt Lake shows where the proposed dikes would be constructed so that part of the lake would be inclosed and could in eighteen months become fresh and so fit for irrigation purposes



Water holding a great deal of mineral matter in suspension is so buoyant a bather cannot sink in it

Officials of the Utah Water Storage Commission, local interests, and engineers of the United States Department of Agriculture are cooperating in a study of the diking plan. It calls for the construction of three dikes, using existing islands as stepping stones, to shut off one entire side of the lake, about one third of its total area, and inclose its main tributaries. Over the piling and fill of the dikes would be laid a smooth concrete top to make a scenic motor highway across the lake. Tolls paid by motorists, it has been suggested, would pay for the reclamation project within approximately fifteen years.

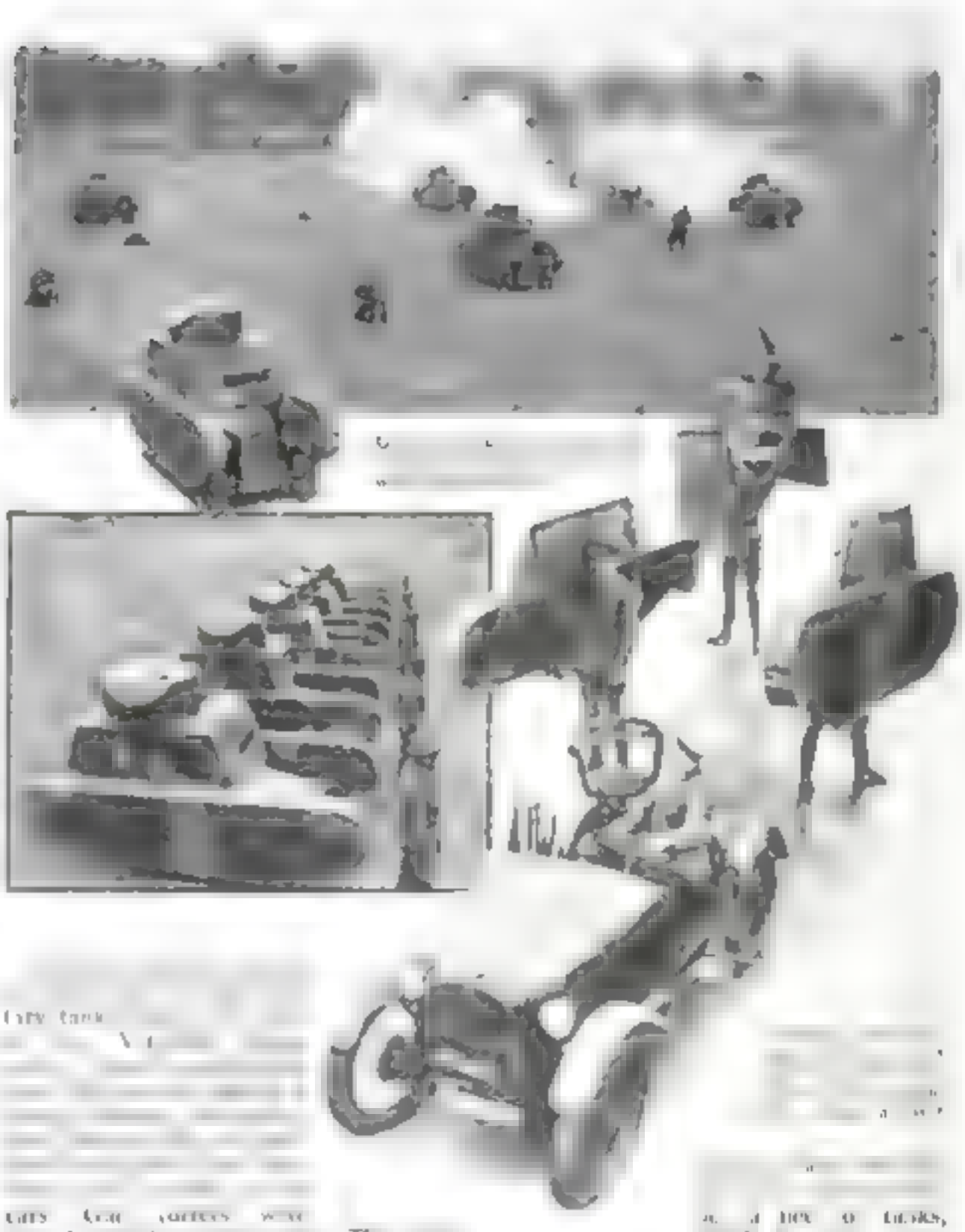
An alternate proposal is to build only two dikes, inclosing a considerably smaller basin around the mouth of the Jordan River. The initial cost of this plan would be less, as only eight miles of dike would be required.

In either case the overflow from the raised water level of the artificial basin, fed by the fresh-water rivers, would flow over the dikes' spillways and into the salt basin beyond. The inclosed area would contain nothing but fresh water after eighteen months, it is estimated. By this time fresh water could be pumped from it and supplied to homes, factories, and farms in the vicinity.

FAKE SHELLS BURST OVER SHAM TANKS

PETROLEUM CARBON NOW USED TO HEAT HOMES

A new use for a by-product has been discovered recently. Petroleum carbon, residue from oil refining plants, contains little besides carbon and burns in residential heating plants with practically no fumes or ash somewhat like ordinary coke. The sample shown above weighs only thirty-nine pounds. Its appearance is that of a sponge, as it is full of air pockets.



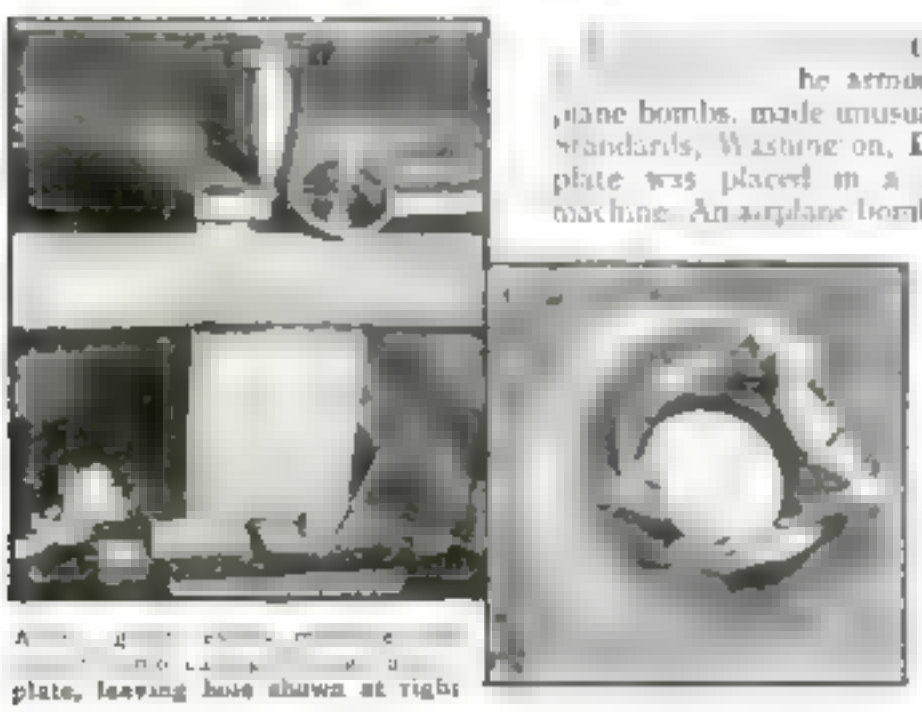
Fake tank

cars [illegible] were placed over the tracers seen. The [illegible] was a realistic imitation of war tanks, the sham vehicles giving a realistic performance as they [illegible] across the [illegible]. The [illegible] of the shell exploded by [illegible] Car [illegible] a [illegible] of tanks, which in some cases runs as high as 3,500. The manic affairs pictured here weigh, excluding the cars, of course, only a few pounds, while the real [illegible] weigh [illegible] pounds.

SPONGE RUBBER SHAVING BRUSH HAS NO BRISTLES

[illegible] of bristles, a new shaving brush uses a piece of rubber sponge to spread the lather. There are no hairs to come out in the brush, according to the maker. Keeps the shave. Shaving cream is squeezed into a depression in the rubber

BOMB CASING FORCED THROUGH ARMOR



A [illegible] plate, leaving hole shown at right

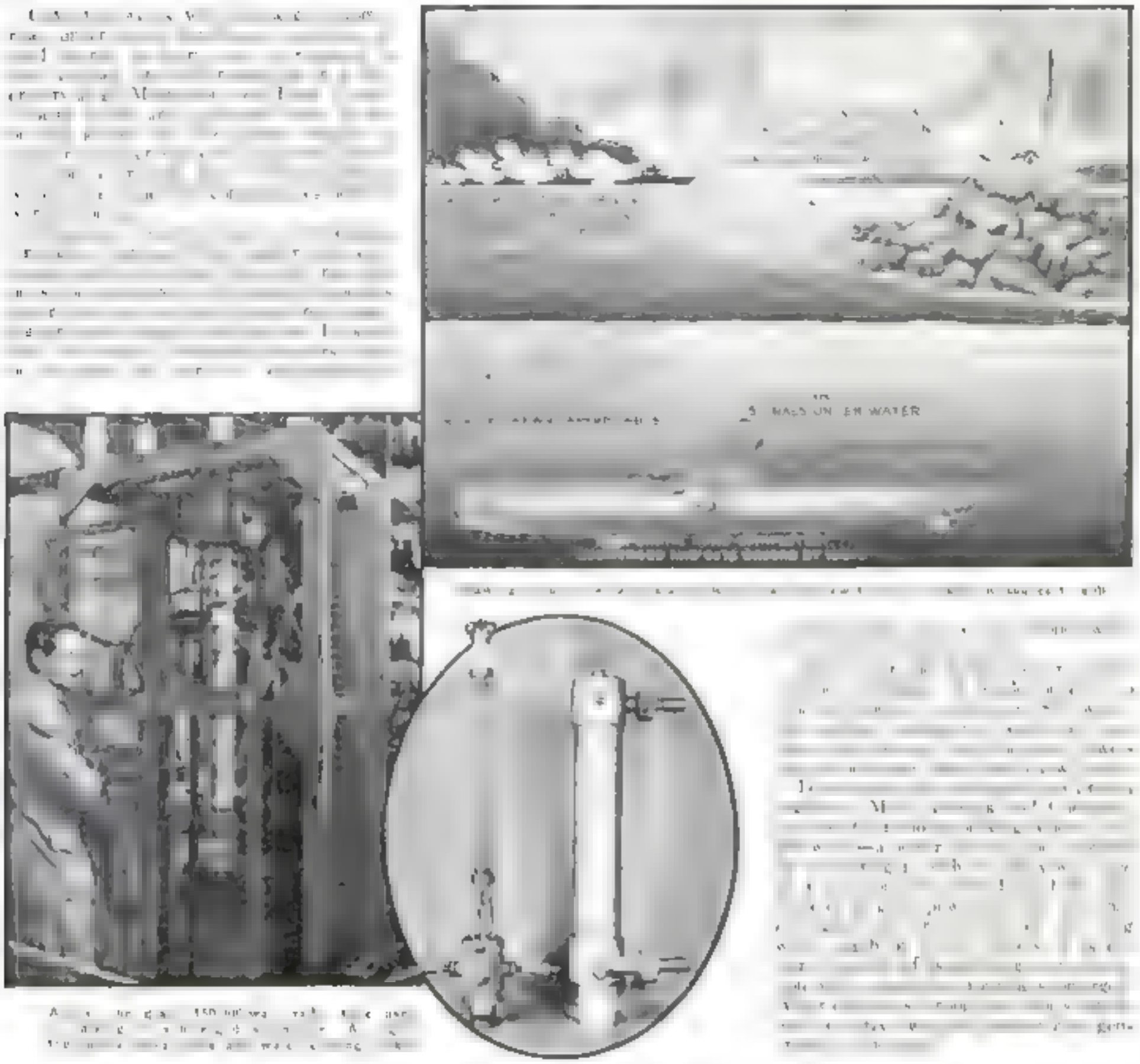
[illegible] States Navy seeking the armor-piercing effects of airplane bombs, made unusual tests at the Bureau of Standards, Washington, D. C. A piece of armor plate was placed in a 2,300,000-pound testing machine. An airplane bomb casing then was secured in the jaws of the machine and slowly pushed through the armor.

The information supplied by this test, it is believed, will be of value in affording greater protection against bombing for cruisers now under construction or planned for the future.

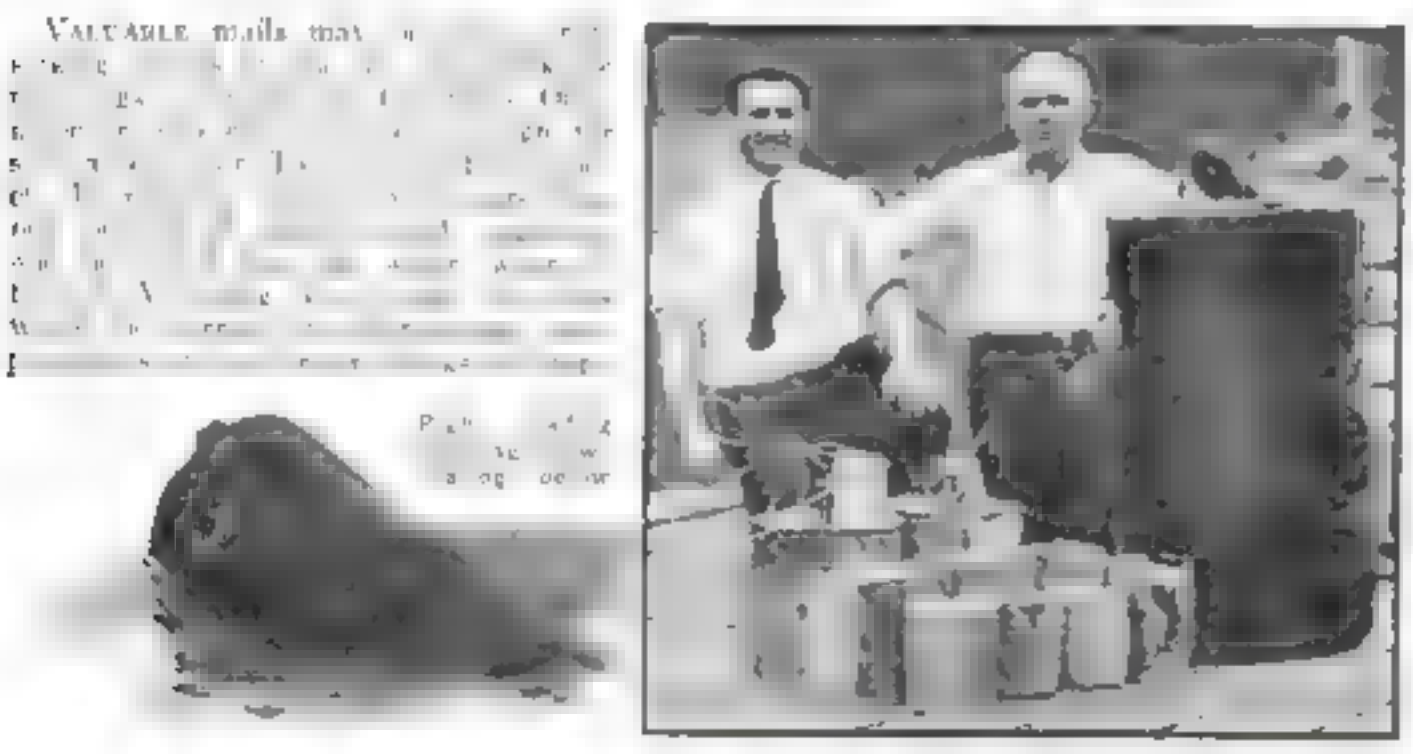
NEW AX HAS BLADE THAT FOLDS AND LOCKS

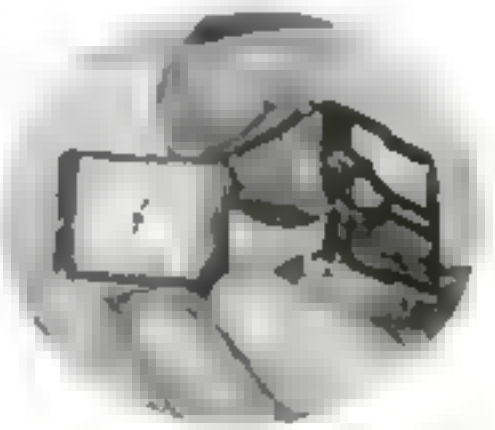
When not in use, the pivoted blade of a new safety ax folds into a recess in the handle and is covered by a guard. Either open or closed, it locks securely. The blade may also be locked in a vertical position for use as a rough planer. According to the manufacturer, the device represents the first radical improvement in axes for years.

Use Giant Radio Tube to Talk to Submerged Craft



NEW MAIL BAG FOR LINERS WON'T SINK





WATCH CLIPS TO BELT OR POCKET

SMALL but practical is a new watch in a folding mount. It clips over the user's belt or upon his waistcoat pocket with tiny sharp prongs, assuring a tight hold. A flip of the finger opens the hinged dial so that the time can be read.

TWENTY THOUSAND YEARS AGO MEN HAD INTOXICANTS

Plainsmen of Siberia had fermented mare's milk, known as *kumiss*, long before the dawn of history. Probably it was the first intoxicating drink to be discovered by man

Stone Age *had* Booze *and*

EARLY WEAVING. The woman at left inserts needle to separate warp for passage of shuttle bearing woof. Egyptian work of art suggests manner in which first cloth was woven

HOW Man, through hundreds of millions of years, developed from a tiny life germ of mysterious origin was told in the early chapters of this series by Dr. W. K. Gregory, of the American Museum of Natural History. The story was continued by Dr. Herbert Ruckes, of the College of the City of New York, who explained the mechanism of inheritance through which Man perpetuates his characteristics. Dr. A. T. Poffenberger, of Columbia University, next sketched the development of Man's mind and emotions. Here the thread was taken up by Dr. Clark Wissler, famous anthropologist of the American Museum of Natural History and Yale University. Last month, Dr Wissler told Michel Mok, staff writer, how Man began the use of fire and stone tools and how he invented houses and wheels. Here he traces the origin of farming; tells what our ancestors ate, drank, and wore, and how they worked metals.

MR. MOK: At the end of our talk last month, Dr Wissler, you told me that men of the New Stone Age raised crops—that farming goes back 20,000 years. What did people eat and drink in those early days?

DR. WISSLER: In the main, they ate about the same things you do—meat, fish, vegetables, bread, cereals, fruit—though the crude way in which they prepared them probably wouldn't please your pampered taste. They did one thing you don't do; or, at least, that you are not supposed to do. They washed their dinner down with a mug of beer or ale and, later, wine.

MR. MOK: Liquor got an early start!

DR. WISSLER: It did. Home-brew came in almost immediately with the raising of grain. But people did not wait for cereals to sprout to get a drink. Before anybody had ever thought of farming, the plainsmen of Siberia discovered that fermented mare's milk was a stimulant. This was probably the world's first intoxicating drink. It is called *kumiss*, and is drunk in parts of Russia today. The liquor problem is nearly as old as liquor itself. Human nature has changed very little. Thousands of years ago, several nations tried to overcome the drink evil with prohibition laws.

MR. MOK: What were they?

DR. WISSLER: I will come to them after a while. First, I want to tell you something about the origin of farming. The curious fact is that women and not men were the first farmers.

MR. MOK: Why was that?

DR. WISSLER: You remember that people began by being big-game hunters (P.S. M., Apr. '32, p. 118). While the men were out hunting, the women gathered roots, tubers, and greens near the settlement of the tribe. Later, when people had got on to the idea of growing plants from seeds, the women raised vegetables in their dooryards and tended their gardens while the men literally brought home the bacon.

MR. MOK: Who first discovered that seeds produced plants?

DR. WISSLER: There are several theories about that. One is that farming was "invented" by one of the many ancient peoples that used to bury a quantity of food, such as tubers and grains, with their dead to feed them in the hereafter. When these primitive people visited the graves again in the spring, so the story goes, they found that the plants had sprouted. One fine day a bright chap among them, after much deep thinking, got the idea that stuff could be raised by planting seeds.

MR. MOK: Do you believe it happened that way?

DR. WISSLER: I have my doubts. People who were smart enough to snare mammoth and cave bear did not need to wait for seeds to come up out of graves to make that discovery. They had pretty keen powers of observation. They saw trees budding and flowers blooming all around them; they must have noticed that certain plants returned every warm season, and understood why. Besides, primitive peoples that cremated their dead became farmers, just like the others.

MR. MOK: What caused the change from hunting to farming, and why did the men and not the women then tend the crops?

DR. WISSLER: The main reason was that people overhunted their neighborhoods and the animals became scarce or

HUMAN NATURE *has changed but little during the last twenty thousand years, as is proved in this thrilling chapter in the*

STORY OF LIFE

The World's Greatest Mystery

Prohibition

How work was done on a Stone Age farm where women were the first farmers, men taking their place when the wild game became scarce

extinct. Of course, this happened gradually. Women remained the only farmers for hundreds of years and, through long experience, improved their skill. As the animals disappeared the men realized that raising crops would make a fine substitute for hunting—it produced plenty of good food right outside their own doors, and with less than half the effort. So, by and by, they took hold of the job themselves and that was the end of the prehistoric farmerettes. By a process of elimination they discovered the best and most nourishing grains

MR. MOK: I suppose bread was invented right after that?

DR. WISSLER: That is what ninety-nine out of a hundred people think but it is putting the cart before the horse As a matter of fact, there were bakers and millers long before there were farmers. Bread was made centuries before the first seeds were planted. The hunters of the Old Stone Age, who knew no more about agriculture than they did about piano playing, baked and ate bread

MR. MOK: How do you know they did?

DR. WISSLER: Because their ancient rolls and wheat cakes have been found in Germany and Switzerland

MR. MOK: Those must be the world's toughest crusts! What were they made of?

DR. WISSLER: Carefully analyzed, they were found to consist of coarsely ground wild grains; a mixture of wheat and barley But even before that, bread of a sort was made from crushed acorns and beechnuts. The Indians of the Pacific slope still eat such crushed-acorn cake. At first, the Stone Age men ate their wild grains raw, as their apelike ancestors had done The next step was to pound them and mix them with water to make them more digestible

MR. MOK: But how did they get the idea of baking?

DR. WISSLER: Some caveman dropped a bit of this mixture on a hot stone, tasted the result, and found it good. This fellow accidentally invented both the griddle and the wheat cake Later, they improved on the process by covering the cakes with hot ashes; that really was the beginning of baking. The new delicacy must have been a welcome change to people who lived on little else but meat, and soon became popular So, you see, the ingredients of the sandwich —meat and bread—are among the oldest foods in the world

MR. MOK: What did the first farmers raise?

DR. WISSLER: Crops have not changed much in 20,000 years. They grew various cereals—chiefly wheat, rye, and barley Many of our vegetables and fruits are just as old. The people of the New Stone Age had turnips, carrots, cabbages, apples, pears, peaches, and grapes.

MR. MOK: That is amazing. You mean that they had all of these fruits and vegetables in the same form in which we use them today?

DR. WISSLER: Not exactly. Some of them you might not recognize in the crude, almost wild state in which they were raised in those days. The early apples, for example, must have resembled the small, gnarled crab apple more than the big, luscious fruit which we have developed. Nevertheless they were the same fruits and vegetables.

MR. MOK: Where did farming start?

DR. WISSLER: I am glad you asked that question, because it gives me

Wooden statuettes from Egypt dating from 2,400 B.C. are said by students to suggest bread-making process used before there was machinery to grind grain or mix dough

Earl H. Morris, left, with human remains, pottery, clothes and basketwork unearthed by him in Mummy Cave in Canyon Del Muerto, Arizona

a chance to clear up an interesting point. When you asked me just now about the first farmers, I took it for granted you meant the farmers of the Old World. You see it is generally believed that farming developed independently in two places—in the Old World and in America.

MR. MOK: What is the reason for that theory?

DR. WISSLER: The fact that entirely different plants were raised. On this continent, you had maize, or Indian corn, white and sweet potatoes, lima and kidney beans, tomatoes, peppers; bananas, pineapples; manioc or cassava, a large tuber like a beet or a big radish, peanuts, cocoa, tobacco, and many others, about sixty in all and not a single one of them European. On the other hand, wheat, rye, barley, and the Old World vegetables and fruits I mentioned a little while ago, all were strangers to America until the white man introduced them. Farming on this continent originated about 10,000 years ago, in Central America. It is there that the wild ancestors of many typically American plants still are found. In the Old World farming started 10,000 years earlier around the eastern border of the Mediterranean Sea.

MR. MOK: Why do you say it began there?

DR. WISSLER: Because it is the home of wild wheat, which still grows there.

MR. MOK: How about brewing?

DR. WISSLER: The subject seems to interest you. Like bread, beer was invented by accident when a prehistoric farmer let some barley mash stand until it fermented. Curiosity did the rest. What happened after he drank the first few jugfuls unfortunately has not been recorded. At any rate, brewing quickly spread far and wide. The ancient Egyptians and other peoples made beer from barley, and in some places it was prepared from rye. However, as I told you in the beginning of our talk, the men of several races had tired of water long before the days of farming, and discovered that there was a kick in fermented mare's milk and also in mead, made from fermented honey.

MR. MOK: How old [illegible]

DR. WISSLER: About 15,000 years. Ancient Egyptian paintings show vineyards, wine presses, and wine jars. According to legend, Noah was the inventor of wine, and the Bible records that he misbehaved once, proving that there is nothing new about the liquor problem.

MR. MOK: Was this country dry in prehistoric times?

DR. WISSLER: If, by this country, you mean North America, it was. The North American Indians were totally ignorant of fermented drinks when the whites introduced them to fire-water. In Central America it was a different matter. There the Indians made chicha with corn or cassava, and fermented the juice of the agave, or century plant, into pulque, which is still drunk in Mexico.

MR. MOK: You promised to tell me something about ancient prohibition laws.

DR. WISSLER: Right. As wine was considered a gift from the gods, ancient peoples used it at their festivals, and especially at religious ceremonies. This is true particularly of the Egyptians and the Greeks. But pretty soon a reaction set in. Religious leaders saw that some people were altogether too eager to honor their gods in that way, even between the holidays, and they proclaimed drinking a sin. The Brahman and Buddhist priests, in India, and later the Mohammedans, forbade it. One of the queerest forms of prohibition was in force among the ancient Aztecs.

MR. MOK: What was their law?

DR. WISSLER: Only old men and women were allowed to indulge at festivals and religious rites, and did so to their hearts' content, but young and middle-aged people were punished severely when found imbibing.

MR. MOK: What was the idea?

DR. WISSLER: The curious part of this rule was that there was nothing religious about it; it was wholly practical and businesslike. Ancient Aztec manuscripts call attention to the necessity of keeping young men and women from drinking because they were the workers in the community.

MR. MOK: How long ago did people begin to make pottery?

DR. WISSLER: The making of pottery goes back about 20,000 years. You understand, of course, that brewing could not have got far without it. People could not carry liquids any distance or keep them long until they had pottery. Nor could they cook satisfactorily; that is, they could and did roast meat over fires, broil it on hot stones, and make cakes on hot stones and in hot ashes, but they could not boil anything properly. Cooking in our sense, therefore, dates from the invention of pottery.

MR. MOK: Where and how did pottery making start?

DR. WISSLER: Nobody knows where it began, and until a few months ago we had only a vague notion as to how it originated, but now we have a fair idea. Recently, Earl H. Morris, archeologist of the Carnegie Institution of Washington, discovered evidences of what I consider one of the earliest stages in pottery making. In the country of the ancient Basket Maker Indians in the Southwest, he found a number of sun-dried pottery vessels. Shredded tree bark had been used as a binding material for the clay, just as the ancient Egyptians used straw in making their sun-dried bricks.

MR. MOK: Do you mean that pottery was first invented in this country?

DR. WISSLER: Oh, no. These old adobe pots date from the second century B.C., and the Old World must have had them thousands of years earlier. But they show what the first attempts at pottery anywhere must have been like. While they were porous and unpractical, they were an advance over what preceded them.

MR. MOK: What did people use before that?

DR. WISSLER: They carried water and other liquids in wooden buckets, pails of bark, bottles of skin, and jars of closely plaited basketwork. Some tribes even succeeded in boiling water by putting hot stones in these baskets. True pottery was invented when some smart chap plastered the inside of *(Continued on page 121)*

Handmade Quakes *Aid Study of Earth*

1. A [illegible] Wh[illegible]

MAKING earthquakes to order is the first step in the efforts of the Harvard University geological department to determine the nature of the deep-lying rocks upon which the continents rest.

These experiments, first of their kind are being carried on by Dr L. Don Leet, director of the Harvard seismograph station, and Chalmer J. Roy and Allen W Waldo, assistants in Harvard's geological department

Headquarters for the experimenters are in a tent, set up in the woods behind a granite quarry in West Quincy, Mass. In the tent is a highly sensitive portable seismograph, anchored into the ground with long iron spikes, a camera capable of recording and timing with a speed of one thousandth of a second, and a portable telephone

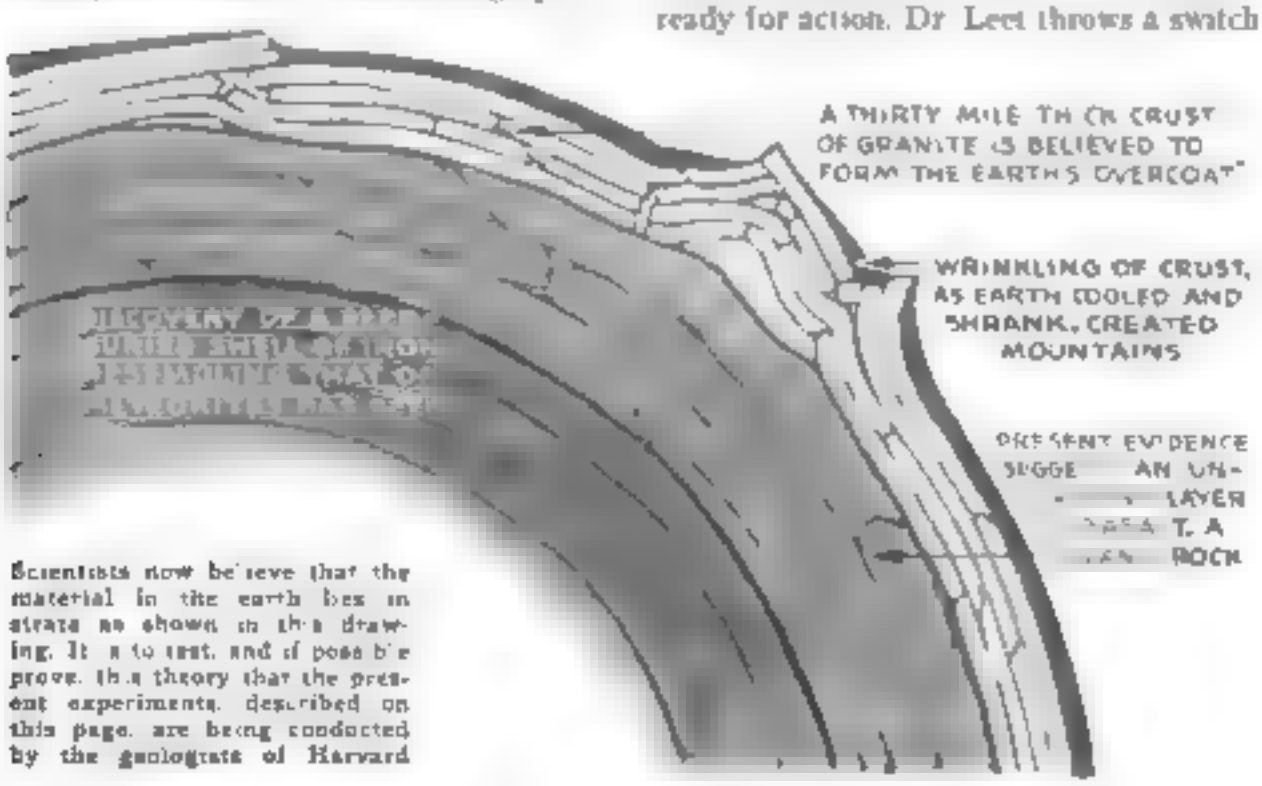
Dynamite cartridges are planted in the ground at distances varying from fifty feet to nearly a mile from the camp. One by one these charges are set off to find the speed at which the vibrations pass through the earth to the seismograph

2. When the dynamite is electrically detonated the speed at which the vibrations travel through granite is recorded by seismograph and split-second camera Photo shows left to right Chalmer J Roy and Allen W Waldo assisting Dr L. Don Leet

After the dynamite has been planted, Dr Leet enters the tent and closes the canvas tightly to exclude all outside illumination The seismograph is made ready, and the camera, which contains a strip of photographic paper, is focused on three tiny, brilliant beams of light reflected from different angles by mirrors.

The vibrations of a tuning fork mark off the sensitive paper by horizontal lines each representing one one hundredth of a second. With each of the instruments ready for action, Dr Leet throws a switch that detonates the dynamite. The delicate machines automatically record the exact time of the electrical contact and the time elapsed before the first vibration reaches the seismograph.

3 Dr Leet examines the photographic record of one of the explosions set off 400 feet from the headquarters At left, record made of the vibrations by the seismographic needle



Scientists now believe that the material in the earth lies in strata as shown in this drawing. It is to test, and if possible prove, this theory that the present experiments, described on this page, are being conducted by the geologists of Harvard

The primary purpose of these measurements is to determine the speed at which the vibrations travel. According to the scientists these data will yield valuable information concerning the materials that form the bed of the continents

It is known that the strata under the surface of the continents are different from those under the bed of the ocean Scientists have reason to believe that granite forms the major portion of the earth's crust. For this reason Dr. Leet and his helpers are making tests in one of the largest granite sections in the country

When the exact speed at which vibrations travel through granite is known, measurements of similar vibrations will be made in all parts of the country and eventually all over the world If the vibrational speed determined in distant portions of the country is found to agree with that recorded in the granite strata in Massachusetts, it will provide reasonable proof that the earth's crust is largely of granite.

MAKE BRICKS BY HAND FOR WASHINGTON'S HOME

W[illegible] manor house at Wakefield, West[illegible] County, Va., near Washington, D. C. they will see a reconstruction of the house in which Washington was born, built of materials and by methods similar to [illegible] employed more than 200 years ago in building the original. Engineers in charge of the reconstruction had to build a Colonial brickyard before they could proceed with the work. Bricks are made in this old plant by hand and fired in a kiln [illegible] fuel as this wood contains no pitch to discolor brick.

[illegible]

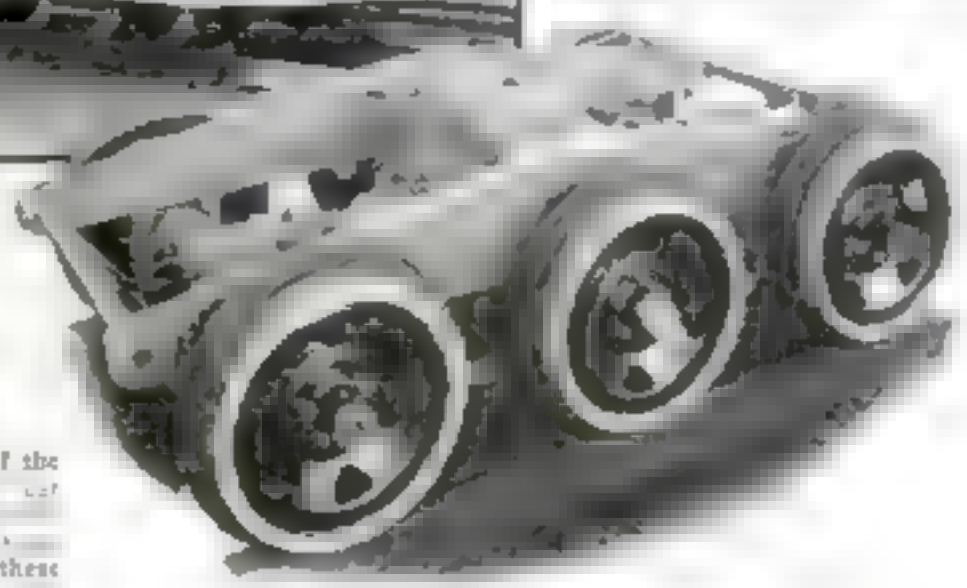
[illegible]

AMERICA TRIES OUT RUBBER-TIRED RAILROAD CARS

[illegible] but travel on railroad tracks have now [illegible] following experiments with them in [illegible] way officials recently witnessed near [illegible] onstration of the first pneumatic-[illegible] United States [illegible] rototypes resembled buses in design, [illegible] are more similarity to an interurban [illegible] of stainless steel makes it economical [illegible] forty passengers, whose comfort is [illegible] ilating ducts. All windows are sealed [illegible] miles an hour, the occupants will feel no jolts because these are absorbed by the twelve air-filled tires.

For the demonstration an eight-cylinder gasoline motor was temporarily installed in the car. Its Philadelphia builders, however, declare it equally well adapted to electric or Diesel power. Cars of this type, it is expected, will enable branch line railroads to meet successfully the competition of bus lines. Cost of operation is placed at twelve cents a mile, exclusive of man power, and it is expected the rubber tires will last for 20,000 miles.

America's first rubber-tired railroad car as it appeared when demonstrated recently near Philadelphia. It seats forty passengers and attains a speed of sixty miles an hour.



At right, a close-up of one of the [illegible] The builder estimates that these tires will last for 20,000 miles.

EXTINCT WINGLESS BIRD LAID THIS BIGGEST EGG

A cross of hen's eggs would be required to equal in bulk a single egg recently mounted for display at the National Museum in Washington, D. C. This mammoth egg was laid by an extinct wingless bird of Madagascar, known as the æpyornis, which man has never seen alive. It is shown above with a hen's egg.

HANDY CASE FOR DRILLS

HANDY for carrying a set of drills is a new "drill index" that fits the pocket. The case is fitted with hinged leaves, each holding a graduated series of drills. Since the numbered holes are drilled to size, the outfit may also be used as a gage.

ROCKET DRIVES SPEEDBOAT MODEL

Various models, driven by rockets, help Engl sh builders to find speed- hull, below, light ng the fuse

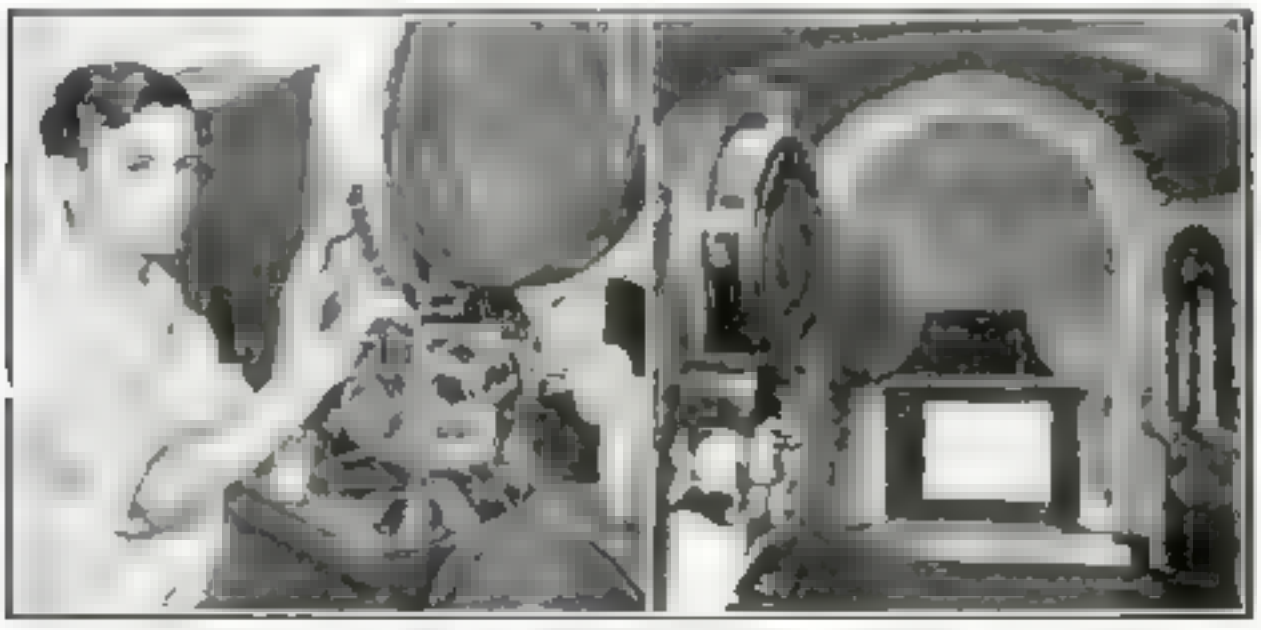
ROCKET-DRIVEN models are being used in England to determine the design for a 5,000-horsepower speedboat, *Miss England III*, to be used in an attempt to win back the world's speed crown for England.

In an effort to select the hull shape capable of the greatest speed, tiny models of various designs are carved in wood and fitted with paper-tube rockets with carefully measured charges of powder. When ready for a test, a model is placed between two floating guides and the rocket is ignited with a long taper. Then the speed of the model and its behavior are carefully observed. In this way a comparison may be made of the most effective shapes.

At this writing the speedboat record is held by Gar Wood, American racer, whose *Miss America IV* attained an official speed of more than 110 miles an hour in a Florida trial last January.

BOY BUILDS HIS OWN TALKIE THEATER

TO ENTERTAIN his family and friends, an Oakland, Calif., boy built his own talkie theater in the basement of his home. The stage, including boxes and proscenium arch, is nine feet wide. An old phonograph motor operates the sound apparatus in the homemade projector. Curtains and lights are controlled by the youthful operator, Stanley Frank, from a switchboard in the projection booth. The stage has all the accessories of a regular theater, including footlights, strip lights, and border lights, and the floor may be removed for a puppet play performance. Scenes for this type of show are hung on pulleys so that they may be lifted out of the way.



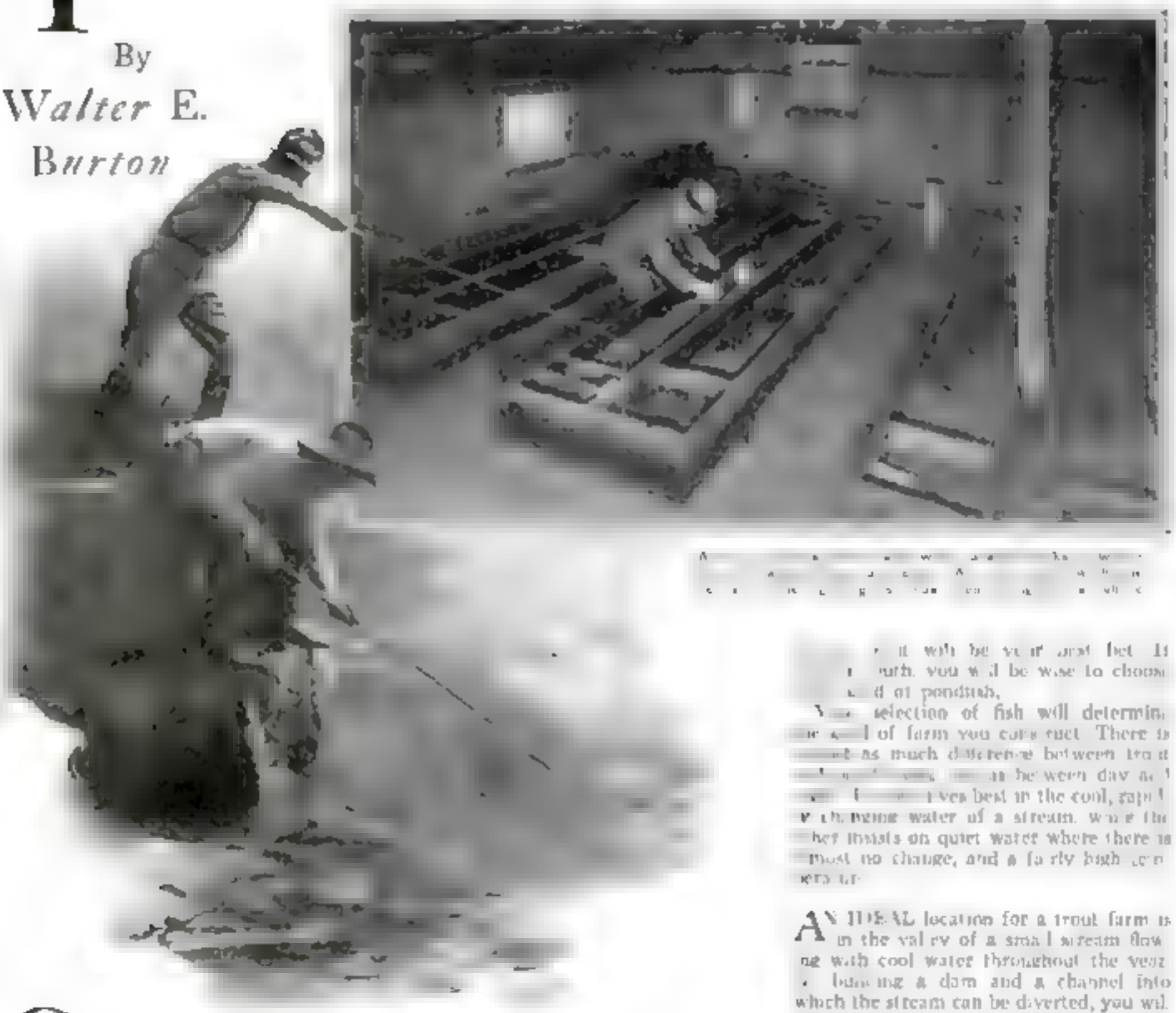
Stanley Frank at the projection machine of his miniature talkie theater seen at right

OVERTURNED CAR SOUNDS HORN, STOPS ENGINE

SHOULD an auto overturn, a new device shuts off the engine and sounds the horn. It consists of a conical cup containing a pair of metal balls. When it is tipped, one of these balls runs against a contact that short-circuits the ignition, while the other closes the horn circuit.

TROUT Raised *by* Hand

By *Walter* E. *Burton*



CITY fishing pools are now booming in some sections, as the midget golf course boomed two years ago. The fad is in full swing on the Pacific Coast and its eastward movement is being rapidly accelerated. It is only a matter of a little time until the tired business man of Chicago, Philadelphia, or New York will have a chance to reach a fishing pool or well-controlled trout stream by a few minutes' travel.

Those who are familiar with both fishing and public amusement tastes predict the fishing pool will have a far more durable popularity than the small golf course. There is a reason for this. Fishing, both as a necessity and a sport, has been a popular activity ever since your remote ancestors learned to make a hook from a piece of bone or to spear fish with a pointed stick. The city fishing pond brings this pastime within the reach of all, and in addition eliminates some of the grief by insuring an abundance of bites.

Trout are the most popular fish for these city fishing pools. To keep a stream well stocked, a well-equipped trout farm, usually located at some distance from the city it serves, is necessary. But this new business of fish farming is not by any means confined to trout. The fish farmer may select as his crop some members of the pondfish group, including bluegills, large- and small-mouth black bass, crappie, sunfish, catfish, and calico, rock, and Warmouth bass. He may choose to raise goldfish, which are distributed by the millions through five-and-ten-cent stores, drug stores, and pet stores. If he lives in the Great Lakes region, particularly near Lakes Erie or Huron, he may capture carp and hold them in captivity while they become fat on whole-kernel corn, and firm-meated from living in clean water instead of the mud of lake beds.

IF YOU were determined to become a fish agriculturist, your first step would be to decide on a location. If you are in the cooler northern portions of the United

[illegible] it will be your best bet. In [illegible] south, you will be wise to choose [illegible] kind of pondfish.

Your selection of fish will determine [illegible] kind of farm you construct. There is [illegible] as much difference between trout [illegible] between day and [illegible] thrives best in the cool, rapid [illegible] of the running water of a stream, while the [illegible] perch insists on quiet water where there is [illegible] most no change, and a fairly high [illegible] temperature.

AN IDEAL location for a trout farm is in the valley of a small stream flowing with cool water throughout the year. Building a dam and a channel into which the stream can be diverted, you will have a good start for a trout farm. You can make pools of concrete, wood, or earth. Clay is a much better material than sand for holding water.

Many trout farms are modeled after those constructed by the United States Bureau of Fisheries. Troughs through which water flows, and in which wire egg trays or baskets are suspended, constitute the hatchery portion. As the eggs hatch, the baby fish fall through between the wires and are caught on the floor of the trough. The eggs are obtained from brood fish before spawning. Dead eggs are removed to prevent infection of the others during incubation.

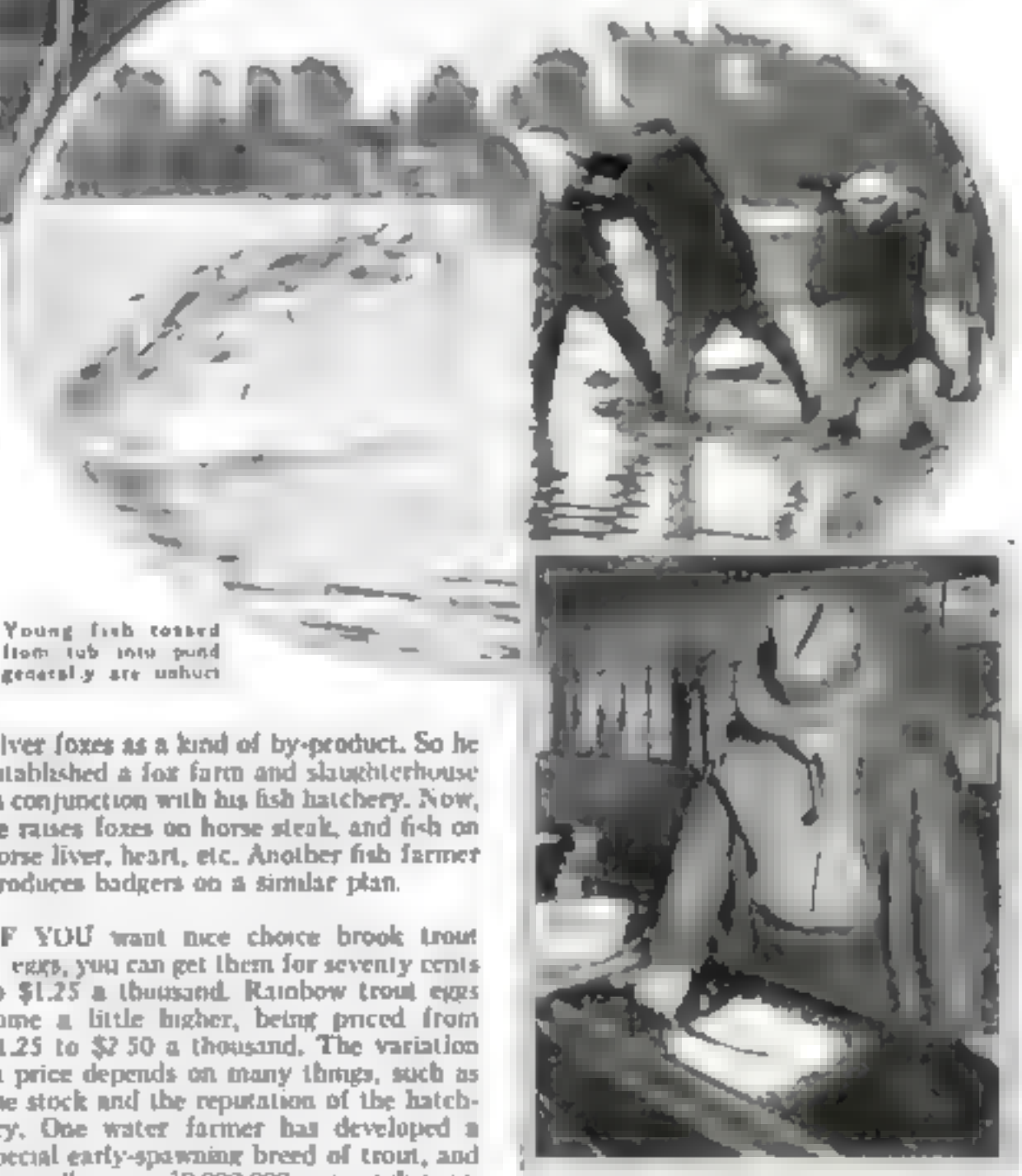
The farmer must provide quarters for his fish while they are growing. Usually several ponds are necessary to keep fish of various sizes, and to hold those that are to be sold.

If, on your water-farming venture, your geographical position makes it advisable for you to raise pondfishes, you will proceed a bit differently. You will construct ponds having earthen sides, and provided with enough inflowing water to make up

for City Fishing Pools

SPORT, Formerly Found Only in Woods and Hills, Now Brought to Door of Businessman and Made to Yield a Comfortable Profit

These wire trays loaded with trout eggs will go into the racks of running water and as they hatch the baby fish will sift to bottom of trough



Young fish tossed from tub into pond generally are unhurt

Trout are not permitted to spawn naturally but the eggs are loaded into wire trays, all bad eggs being removed to prevent infection

fur evaporation and seepage. You will introduce your brood stock and let them conduct their own family-raising affairs. Then for best results you will separate the young from the adults, placing the little fish in ponds where there is an abundance of plant growth. Trout can be fed on raw meat and other food that may be supplied artificially, but pondfish usually refuse food other than that which they obtain alive from the pond itself. Because plant life is the producer of nourishment for the fish, ponds are fertilized from time to time to make the vegetation more luxuriant.

Sometimes, when the natural source of food is insufficient, auxiliary feeding must be done. Minnows or other small fish can be introduced and permitted to multiply as food for the larger fish.

When a baby trout takes to the water, it has a yolk sack attached to its body. This sack, a hangover from the egg period, provides food for a time. Then the fish farmer must come to the rescue with ground beef liver, usually of a grade that has been declared unfit for human use. This liver, being costly, is fed no longer than necessary. Then the trout is put on a regulation diet of lungs, livers, spleens, or hearts from hogs, sheep, and cattle; horse meat; salmon that died after spawning; herring; shrimp meal; dried milk or buttermilk.

Trout recently entered the millionaire class by having caviar added to their diet. Several Russians who were familiar with the making of caviar developed a way of preserving salmon eggs so that they form a suitable fish food. The eggs, like fresh meat, usually are mixed with beans, wheat middlings, and cod-liver oil. They are served raw, while meat may be either raw or cooked.

One trout farmer decided he could grow silver foxes as a kind of by-product. So he established a fox farm and slaughterhouse in conjunction with his fish hatchery. Now, he raises foxes on horse steak, and fish on horse liver, heart, etc. Another fish farmer produces badgers on a similar plan.

IF YOU want nice choice brook trout eggs, you can get them for seventy cents to $1.25 a thousand. Rainbow trout eggs come a little higher, being priced from $1.25 to $2.50 a thousand. The variation in price depends on many things, such as the stock and the reputation of the hatchery. One water farmer has developed a special early-spawning breed of trout, and now sells some 30,000,000 eggs each year.

When it comes to distributing his products, the fish farmer finds numerous avenues. Even before the city-pool idea spread, commercial fisheries were letting customers catch their own fish out of the pools. When a fish was caught, an attendant weighed it, cleaned it, and charged accordingly. Even today, the cost of live fish is the same as dead ones at many hatcheries. This condition is not expected to last long, because of the rapid spread of the metropolitan pool idea.

Sales to sportsmen's clubs, municipal governments, and other agencies for stocking purposes constitute much of the fish-farmer's business. Live fish are transported in five- or ten-gallon tanks, usually on motor trucks. Splashing of the water aerates it sufficiently on short trips. On longer hauls, pumps or oxygen tanks are used.

Carp, close relatives of goldfish, are not important food fish. Buffalofish are likewise ignored. Nevertheless, sales of carp and buffalofish have reached 40,000,000 pounds a year, with a value of $3,000,000.

The Great *(Continued on page 115)*

34,400

Americans Were Killed by Automobiles in 1931

Compared to historic disasters, this is

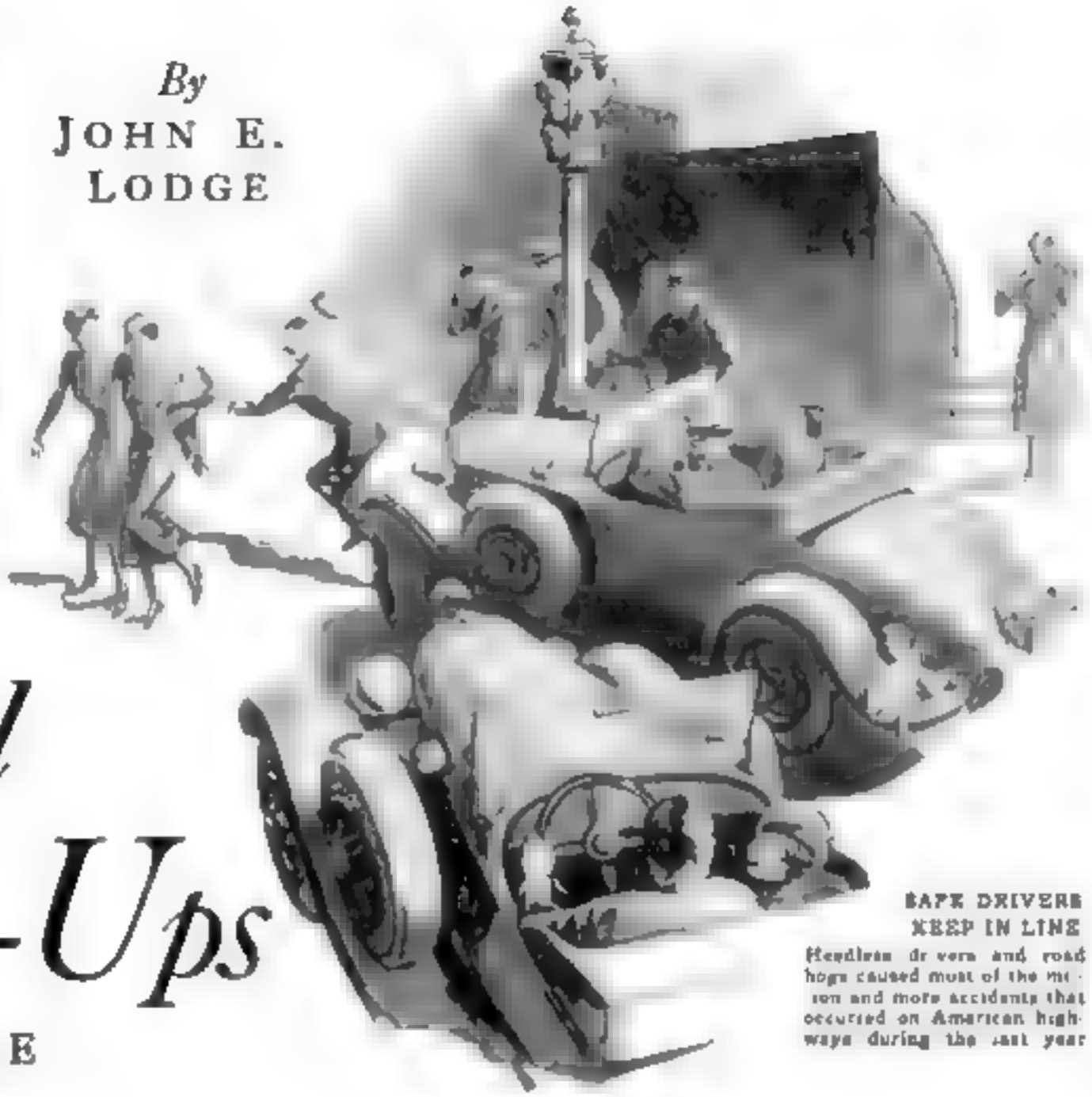
More than five times the number of lives lost in the great Galveston Flood of 1900

Nearly twelve times the number of lives lost in the Johnstown Flood of 1889

Nearly sixty-nine times the number of lives lost in the San Francisco Earthquake of 1906

By JOHN E. LODGE

Fatal Smash-Ups PROVE



SAFE DRIVERS KEEP IN LINE

Heedless drivers and road hogs caused most of the million and more accidents that occurred on American highways during the last year

CARS SAFE... DRIVERS RECKLESS

BETWEEN six and seven o'clock on Tuesday morning is the safest hour in the week to ride in an automobile. The most dangerous hour is between five and six on Sunday afternoon. Automobile accidents happen most frequently in broad daylight, on clear days, when roads are dry. If the driver of the car is between twenty and thirty years old, the chances of an accident taking place are eighty-one percent greater than if he is between forty and fifty.

Such surprising and little-known facts about automobile accidents have been brought out by an analysis recently completed by statisticians of The Travelers Insurance Company, in Hartford, Conn.

Although half a million fewer cars ran on American highways in 1931 than in 1930, the number of automobile deaths and serious injuries last year increased over the year before. Fatalities from collisions between machines jumped ahead twenty-four percent; serious injuries advanced four and a half percent; and for every 100 people killed by automobiles in 1930, there were 103 killed in 1931.

The toll for the twelve months of 1931 was 34,400 persons dead and nearly 1,000,000 injured. In fact, if some great catastrophe had swept across the country, killing or injuring every man, woman, and child in Delaware, Washington, D. C., Wyoming, and Nevada, the casualty list would have exceeded this figure by only 17,000.

In the eighteen months ending December 31, 1931, more Americans were killed by cars than died in the front-line trenches in eighteen months of the World War.

What are the causes behind the rapidly increasing hazards of motoring? What is the commonest mistake made by drivers, leading to accidents? How often are defective machines to blame? Where do most accidents occur? Are women more dangerous drivers than men? These, and other questions, the insurance company experts set out to answer.

In at least nine out of ten automobile accidents, they found, the cause can be traced directly to an error made either by a driver or a pedestrian. Only once in twenty times is the machine definitely at fault.

The commonest mistake made by a driver, leading to a fatality, is driving off the roadway. Last year, it accounted for 6,390 lives and 60,030 accidents. Next came exceeding the speed limit for the time and place, with 3,920 fatalities and 67,080 accidents. Third on the list was going ahead without having the right of way. It resulted in the death of 3,140 persons and the greatest number of accidents of all, 119,350.

Other important factors in accidents caused by drivers were: reckless driving, with a total of 2,610 fatalities and 34,830 accidents; driving on the wrong side of the road, with 2,340 deaths and 62,560 accidents; skidding, with 1,740 deaths and 44,510 accidents; and cutting in, with 860 deaths and 33,540 accidents. Passing on a curve or hill was responsible for 4,520 accidents and 280 deaths and failing to signal, or signaling improperly, for 27,740 accidents and 260 deaths.

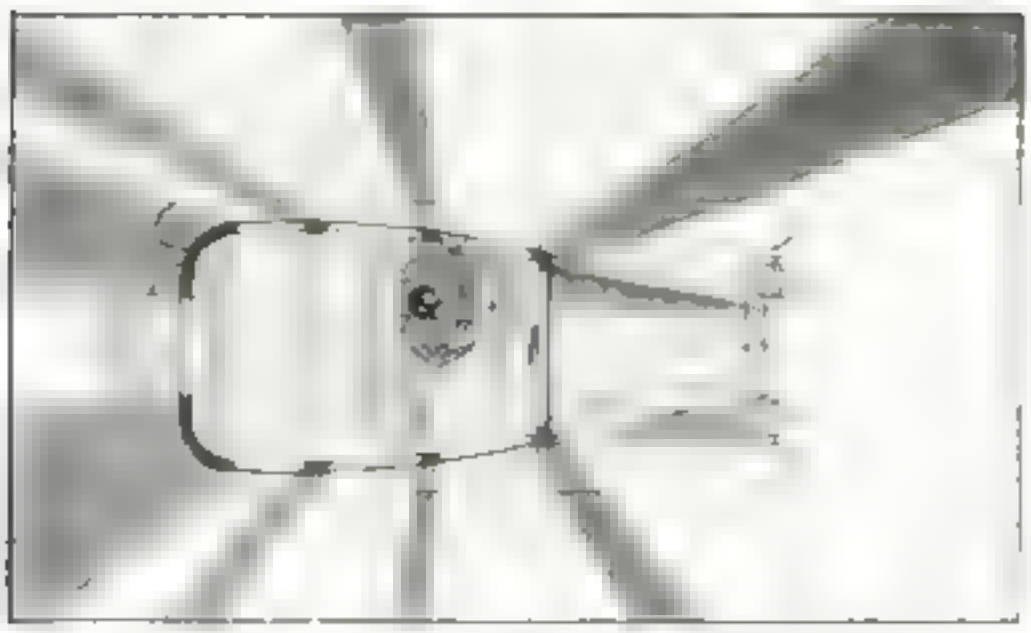
As a traffic hazard, left turns, charged with 800 deaths and 56,760 accidents, ran far ahead of right turns, with 390 fatalities and 21,930 accidents. Runaway cars without drivers, during the twelve months, killed 210 persons and caused 2,580 accidents.

The "weaving driver," the speeder, and the "road hog" are the three types of motorists who cause most highway accidents. Among pedestrians, those who cross the street in the middle of the block, walk in the direction of traffic on country roads, or step out into the street from behind parked cars are responsible for a majority of accidents in which those on foot are struck by passing autos.

The number of pedestrians run down by automobiles in 1931 exceeded 310,000, and 14,500 of these were killed. One out of every four fatalities of this kind resulted from crossing thoroughfares in the middle of the block; one out of every six from children playing in the streets, one out of every ten from stepping out from behind parked machines; and one out of every twenty-five from walking on rural highways.

Those who have to walk along country roads, the investigators suggest, should always face approaching traffic, carry

This Article Tells How Poor Drivers Have Increased Motoring Hazards Despite Improved Roads and Cars



Supports and other obstructions in closed cars now so commonly in use cause blind spots, as shown in the drawing, and are responsible for many crashes

Diagram showing how wrong or indolent signal causes left-turn accidents. Note that arm drooping over side of the car is barely visible

lights at night, and never allow two cars to come abreast of them. Because many pedestrians are killed before motorists can bring their cars to a stop, drivers should reduce speed at night so they can always stop their machines within the space illuminated by their headlights.

The average person takes half a second to react to an emergency and apply the brakes. In addition, at a speed of fifty-five miles an hour, it takes more than a block to bring a car to a halt with two-wheel brakes, and more than half a block with four-wheel brakes. When tires are worn, or roads are wet or the grade downward the distance is increased. In one out of four accidents, last year, the cars had two-wheel brakes. It used to be thought that ability to react quickly in an emergency depended upon the intelligence rating of the driver. But one recent test of a large number of motorists showed that the operator with the quickest reaction time was of low mentality.

In only 56,330 cases, out of 1,281,400 accidents studied, were the crashes due to mechanical failure. The machines were in apparently good condition at the time 1,225,070 of the mishaps occurred. When the cars were at fault, defective brakes led the list as a cause, accounting for 18,290 accidents. In the order named, other defects contributed to the accident toll: Lack of chains on slippery roads, blowouts and punctures, one or both headlights out, defective steering gear, glaring headlights, taillights out or obstructed.

While it is still being debated whether the increasing average speed of automobiles and the lifting of the speed limit on country roads is causing more accidents, the investigation shows undeniably that the stepping up of speeds has increased the seriousness of accidents when they have occurred. The greater proportion of people killed or permanently crippled in automobile accidents last year is attributed to the increase in average speed.

An automobile going sixty miles an hour strikes an object with an impact as great as though it had been driven over the edge of a ten-story building and had crashed on the pavement 120 feet below. Incidentally, researches just made by the Chicago Motor Club, in Illinois, reveal that traveling a mile a minute is three times as expensive as motoring at forty-five miles an hour. The extra fifteen miles an hour trebles the upkeep costs of the car.

The increased speed and power of modern cars is given as one of the reasons why rates on public liability and property damage insurance went up in seven-eighths of the states February 1, 1932. A study of the records from 1927 to 1930 showed that the number and seriousness of automobile accidents had greatly increased the amounts paid out in claims.

In all states except Texas, Oklahoma, Minnesota, Maine, New Hampshire, and Vermont, the rates were raised the average for the entire country being an advance of between ten and twenty-five percent. More improved roads, a greater number of closed automobiles, increased congestion, more mileage, and an increased family use of automobiles are other factors considered by the insurance companies as contributing to the greater number of accidents.

Recently a credit organization in a southern city reported that one fourth of all drivers having collisions there were listed as "bad credit risks." The confidential reports, which are used as a basis for extending credit, showed they had characteristics such as lack of consideration for others, carelessness, use of intoxicating liquors, recklessness of consequence, or other habits which marked them as dangerous drivers. About six percent of the general population, the report points out are bad risks. They can be identified beforehand and should be refused drivers licenses.

Between five and six o'clock in the evening is the most dangerous hour on American roads and the hazard is greatest on Sunday. Between six and seven on Tuesday morning is the safest hour, the records show

FACE TRAFFIC WHEN ON FOOT

Pedestrians on a highway can reduce the hazard by facing traffic and avoid cars abreast

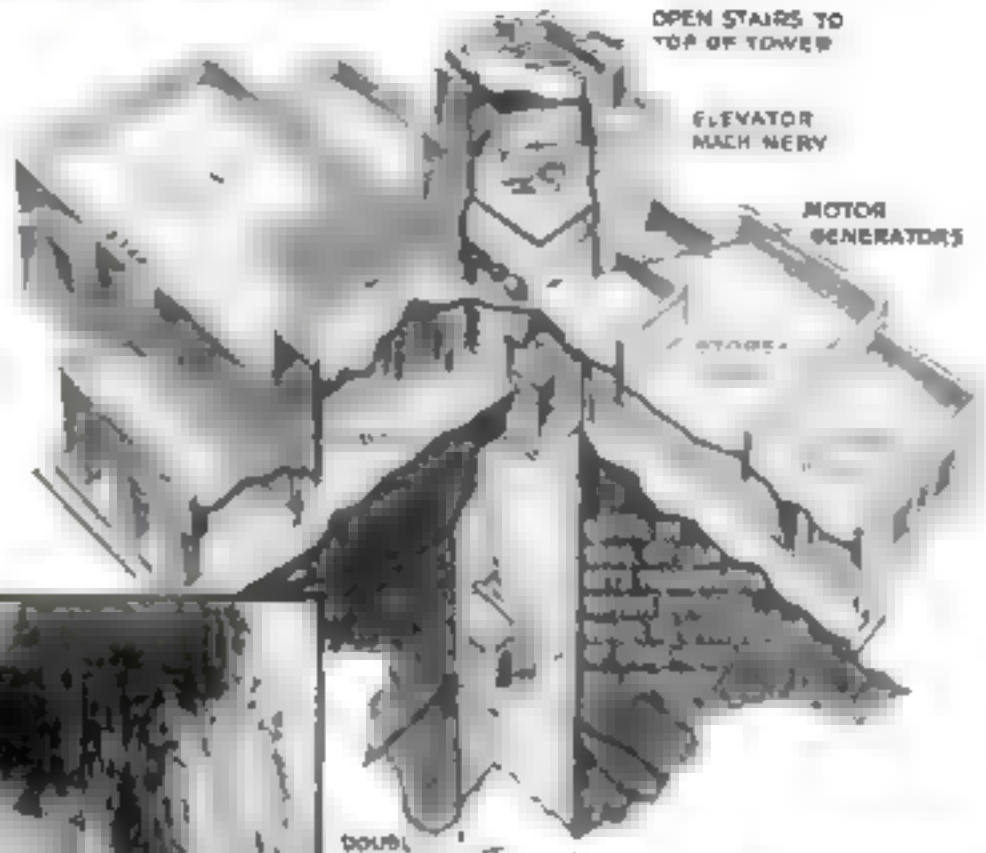
If you ask most people under what road conditions a majority of auto accidents occur, you will probably be told "Icy roads" or "wet streets." As a matter of fact, the insurance company experts found that only three percent of the 1931 accidents occurred on icy surfaces and less than sixteen percent on wet surfaces. In eighty-one percent of all mishaps, the roads were dry. And, for accidents which resulted in fatalities, the figure was eighty-four percent.

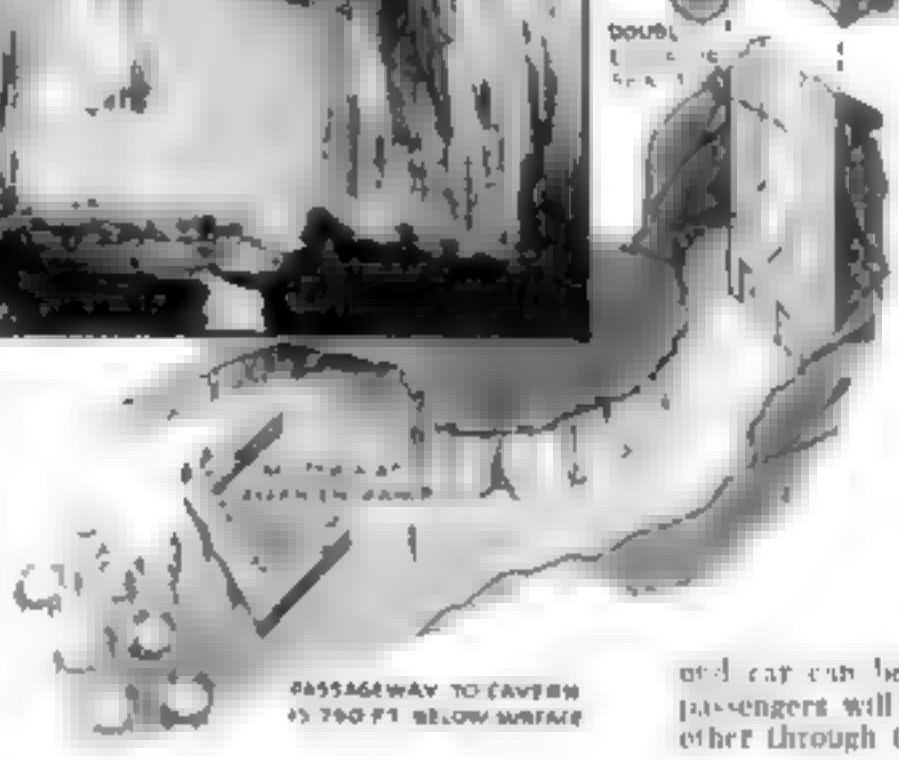
Also, eighty-five out of every hundred accidents resulting in deaths occurred under clear weather conditions. Less than one percent took place when it was snowing, less than six percent when it was cloudy, and less (Continued on page 124)

Elevators Whisk Tourists to Bottom of 750-Foot Cave

Along this winding ramp, visitors to the famous Carlsbad Caverns, New Mexico, tramped the 750-foot drop from surface level to the bottom of the cave before the installation of the elevators

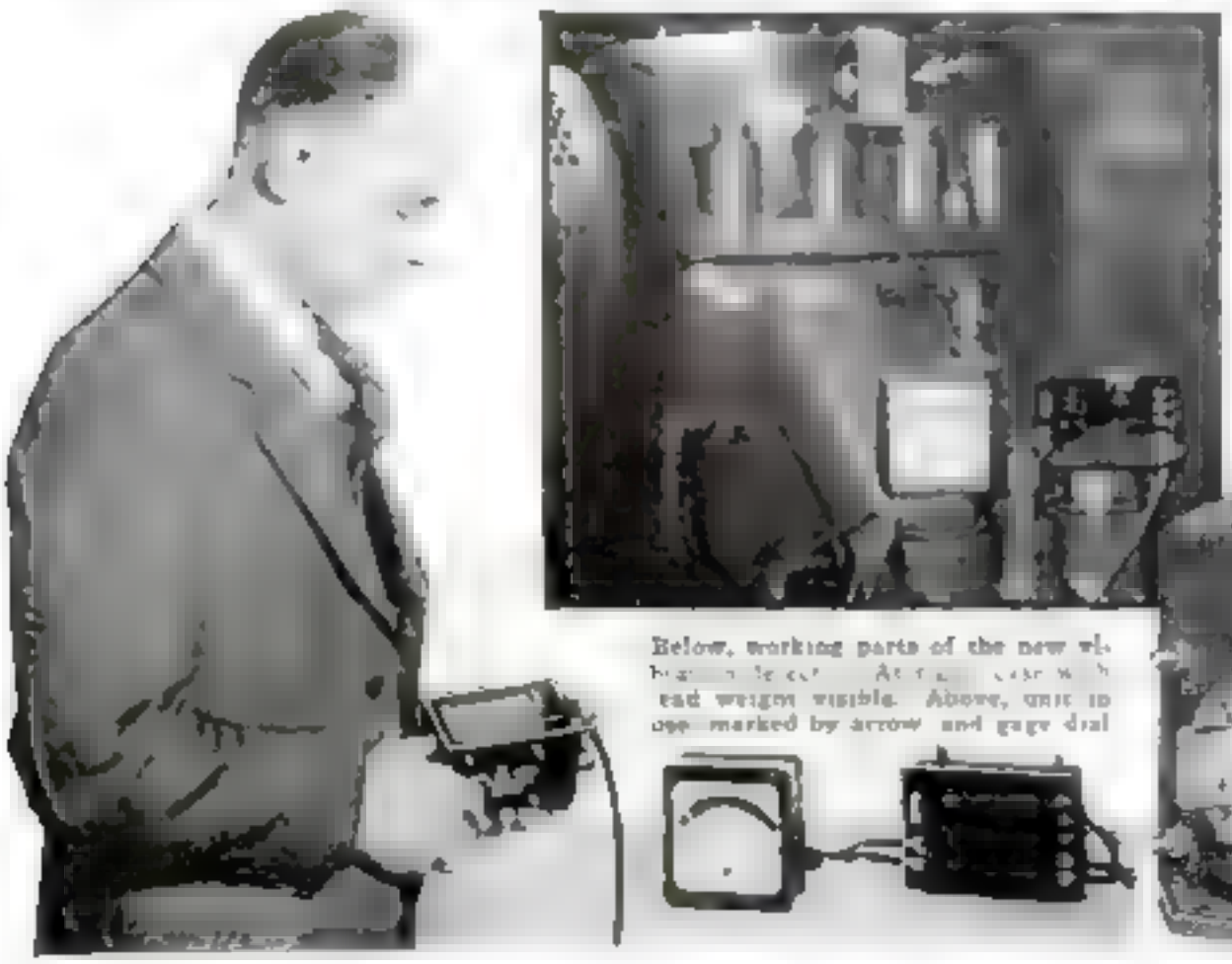
At right, one of the main rooms in the mighty Carlsbad Caverns which can now be reached easily by means of the elevators shown in the drawing





Visitors to Carlsbad Caverns National Park, New Mexico, now are whisked by elevator up and down in the famous caverns. One car recently was placed in operation and a second will be running soon carrying visitors the 750 feet from ground level to the floor of the cave. By the time the second car is in operation a one-story structure resembling an Indian pueblo will house the ground level entrance. Rising from its center will be a three-story tower containing elevator machinery and topped by an observation platform. The elevators there make no intermediate stops between ground level and cave floor. To prevent the possibility of passengers being trapped part way down the shaft by a possible breakdown of machinery, each car will be fitted with a side door. In an emergency, the second car can be called by telephone, and passengers will pass from one car to the other through the side doors

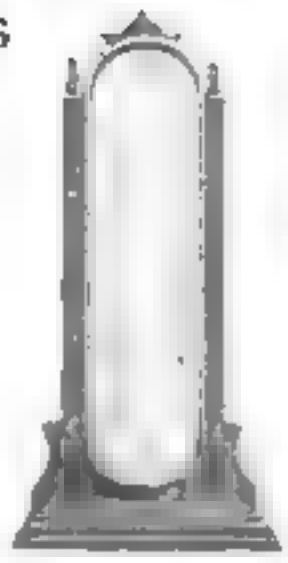
VIBRATIONS IN MACHINERY GAGED BY TINY SEISMOGRAPH



Below, working parts of the new vi- ... lead weight visible. Above, unit in ... marked by arrow and gage dial

...r the earthquake detec- ... a miniature instrument ... d to measure the vibra- ...achinery running at full ...s in construction are ...ected before the piece ... Developed by General ... the instrument records ...ght that they can be ... thousandths of an inch. ... of the instrument, con- ...g lead weight, is bolted ... being tested, and vi- ...brates with it. The lead weight, because of inertia, tends to remain stationary. Bar magnets on the vibrating case generate a minute electric current as they move past coils on the stationary weight. This current, recorded on a sensitive meter, affords an accurate measure of the degree of vibration.

NEW CLOCK IS ONE-HANDED



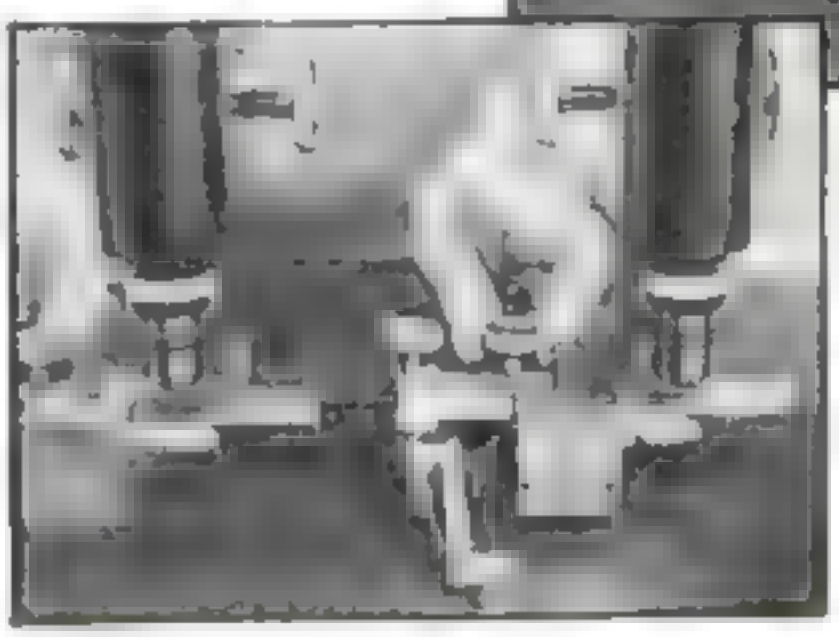
A single hand, moving around the oval face of an odd clock designed by a Jefferson, Ohio, inventor, makes two complete revolutions daily. Large numbers from one to twelve indicate the hours, while the minutes are shown by smaller figures. A novel system of gearing was required to obtain the unusual motion of the hand. The designer maintains that it is easier to tell time by his clock than by one with a conventional face and two hands.

MICROSCOPE WITH TWO EYEPIECES REVEALS CRIME

[illegible]

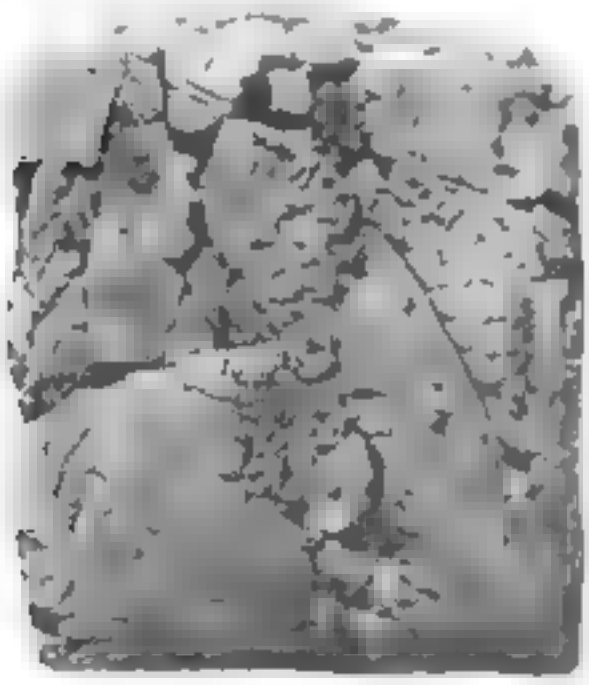
[illegible]

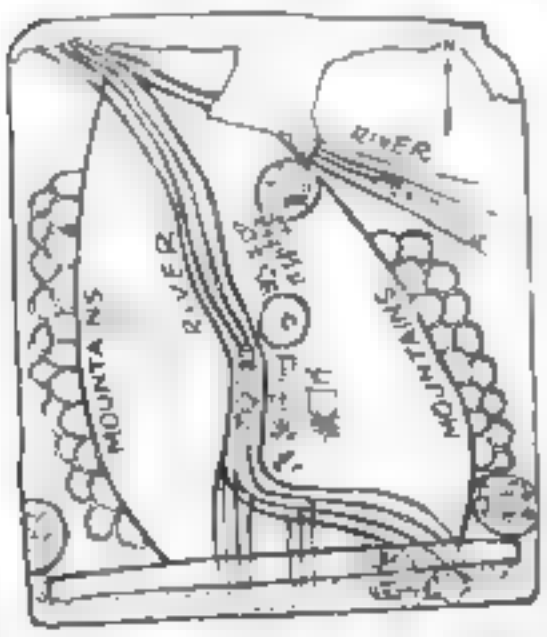
At left, note that two bullets are in place beneath the [illegible]



4,000-YEAR-OLD MAP FOUND NEAR BABYLON

The oldest map in the world was discovered the other day in an excavation 200 miles north of Babylon, in Mesopotamia. Marked on a clay tablet of a size that could be hidden in the hollow of a hand, its age is estimated at 2,500 B. C. It maps a rich man's estate, showing clearly the topography. Mountains are indicated with scallop markings, in the fashion of Babylonians centuries later. The small wedged-shaped characters are those of early Sumerian writing.





At top, oldest map in the world found in Mesopotamia, and above drawing made from it

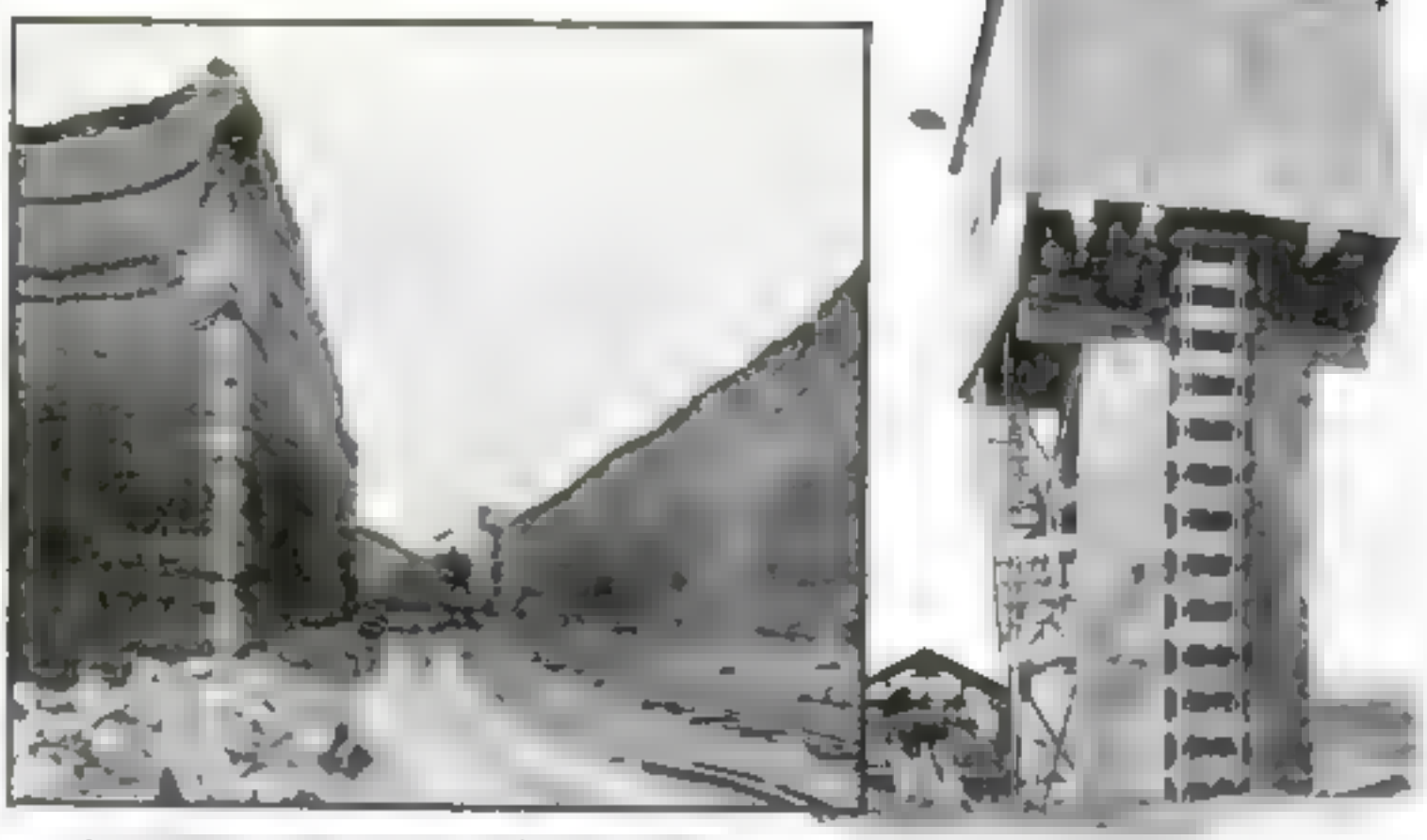
DENTIST KEEPS TOOLS IN DOLL HOUSE

Child patients do not shudder in anticipatory dread when a Los Angeles, Calif., dentist reaches for one of his tools. They are kept in the drawers of a model doll house that serves as a cabinet. The dentist's experience with this aid has shown him a shrewd psychologist, for instead of causing fear he now excites the curiosity of his youthful patients when he reaches for one of his instruments.

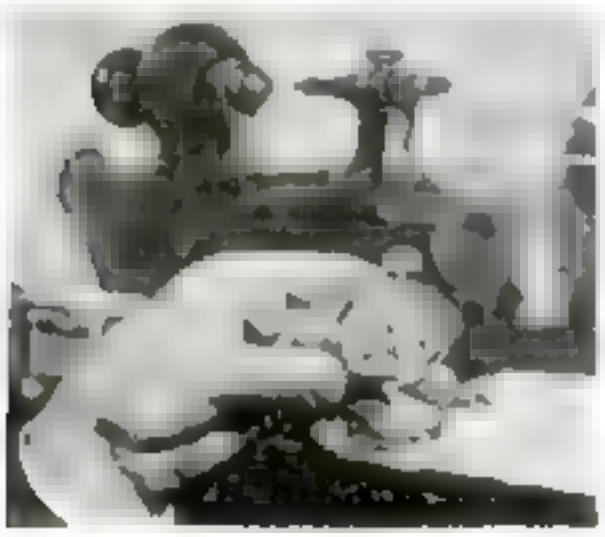
Children experience no thrills of dread and terror when this Los Angeles dentist reaches for a drill or lancet, as he keeps them in the drawers of the doll house, and curiosity replaces fear

GIANT MACHINE SHAVES OFF HILLSIDE

HILLSIDES are neatly shaved by a giant traveling machine that is expected to prove an innovation in digging and quarrying methods. Buckets moving upward on an endless chain scoop off the face of the hill and empty their material in a hopper on the other side. The device, especially intended for clay digging, can remove fifty tons of dirt an hour, thus doing the work of a small army of men using hand tools. It can also shave limestone or shale for making cement and other products, doing away with drilling and blasting and delivering a fine, uniform mixture. Photo at extreme right shows the cutting buckets on endless chain.



Above is a 90-ton caterpillar tractor shown with the big digging boom at right. Note cutting buckets on endless chain

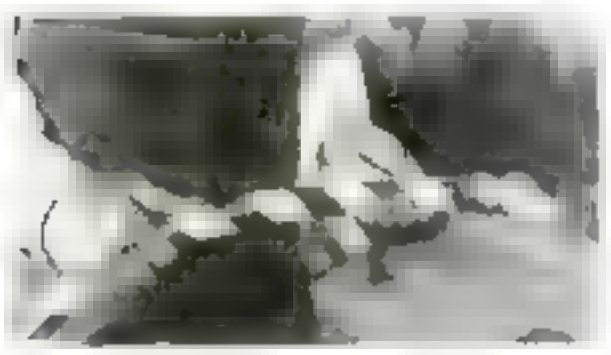


WATCH RUNS BACKWARD

WHAT is said to be the only watch in the world that runs backward has been constructed by a master watchmaker of San Antonio, Tex. Its hands travel counterclockwise and the numerals run from one to twelve in the same direction. The odd timepiece is mounted in the window of its builder's shop, where it draws the attention of passers-by.

CATCH ELEVEN-FOOT CRAB NEAR JAPAN

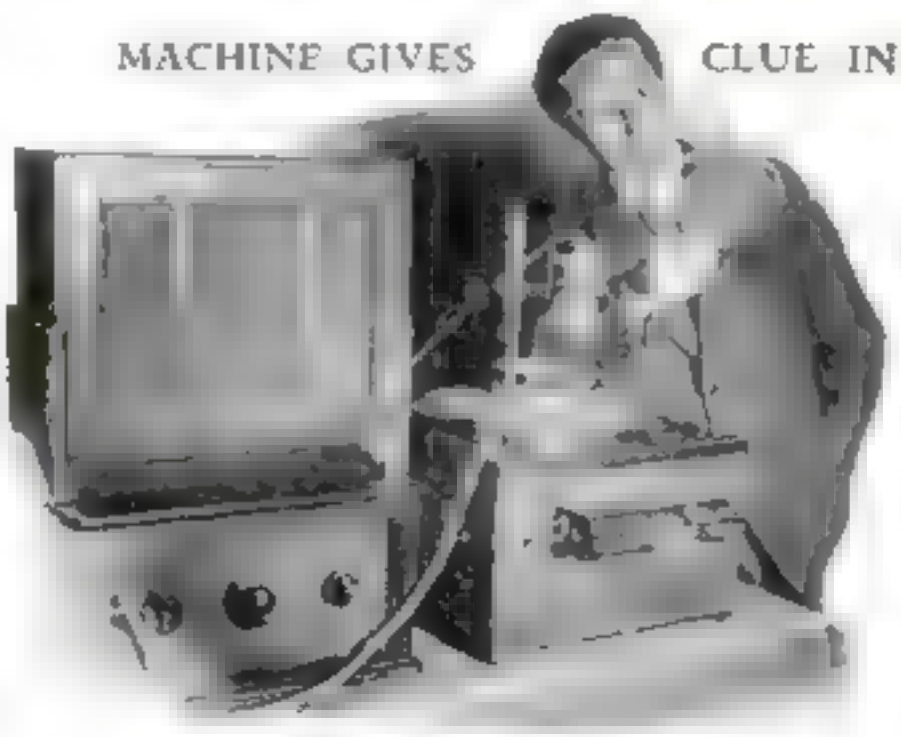
VISITORS to the National Museum at Washington, D. C., may now see a full-fledged specimen of Japan's "nightmare crab," which, with claws extended, has a span of more than eleven feet. Fortunately for bathers perhaps, the aquatic monster does not stray into shallow waters. It inhabits the 300-fathom depths of Sagami Bay, Japan. On rare occasions specimens are hauled up by the long lines of deep-sea fisheries. The photograph at the right shows W. M. Perrygo, of the museum staff, preparing the crab for exhibition, while an American crab is exhibited for comparison.



BRIGHT COLORS ON HOSE DISCOURAGE THIEVES

THEFT-PROOF garden hose, striped with colors in barber-pole fashion, has been placed on the market. According to the maker, the distinctive combination discourages petty thieves. It is intended especially for public parks, clubs, and large estates, and different color combinations insure individuality.

MACHINE GIVES CLUE IN HEART DISEASE



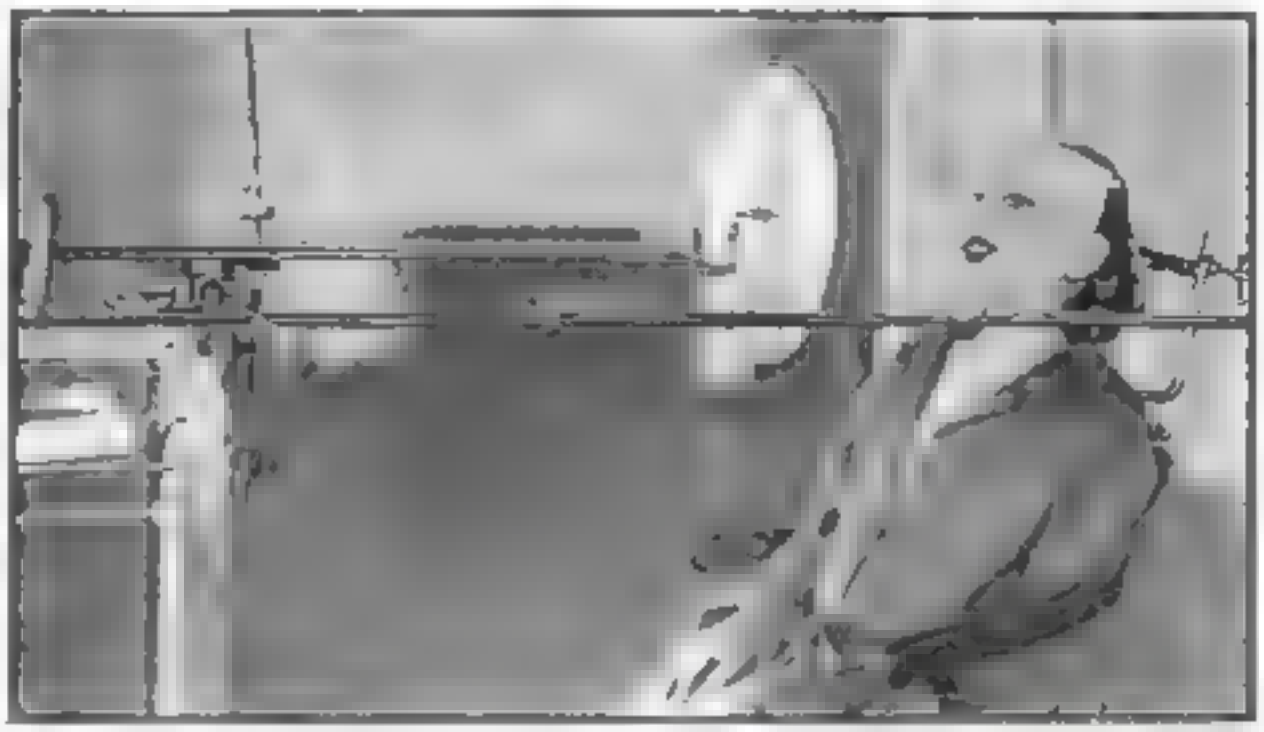
HEARTBEATS of hospital patients with typical forms of heart trouble recently were recorded upon glass disks in Germany through a new process. A machine resembling a phonograph plays the records, using a photoelectric pick-up with a light-sensitive cell and a loudspeaker. Listening to a patients' heartbeats, a doctor can compare them with those on the sound records and make a quick and accurate diagnosis.

BLIND PERSONS' SIXTH SENSE FOUND IN THE EARS

HAVE the blind a "sixth sense" by which they feel obstacles before they touch them? When persons long blind approach a foreign object, they experience a slight sensation of being touched on the face. To study conflicting theories for this mysterious phenomenon, Dr. Vladimir Dolansky, psychologist of Warsaw, Poland, set up an "artificial obstacle" a disk that could be shifted toward a subject.

Even when the subject's face was covered by a cardboard mask he could detect the approach of the disk. But the subject's sensation ceased when his ears were plugged. This solved the mystery.

The blind have developed such acuteness of hearing, Dr. Dolansky concludes, that they can detect the faintest sounds echoed from the obstacle. Almost instinctive is their fear of a collision, and this contracts hair follicles on the face. The tingling facial sensation that results is the blind person's so-called "sixth sense."

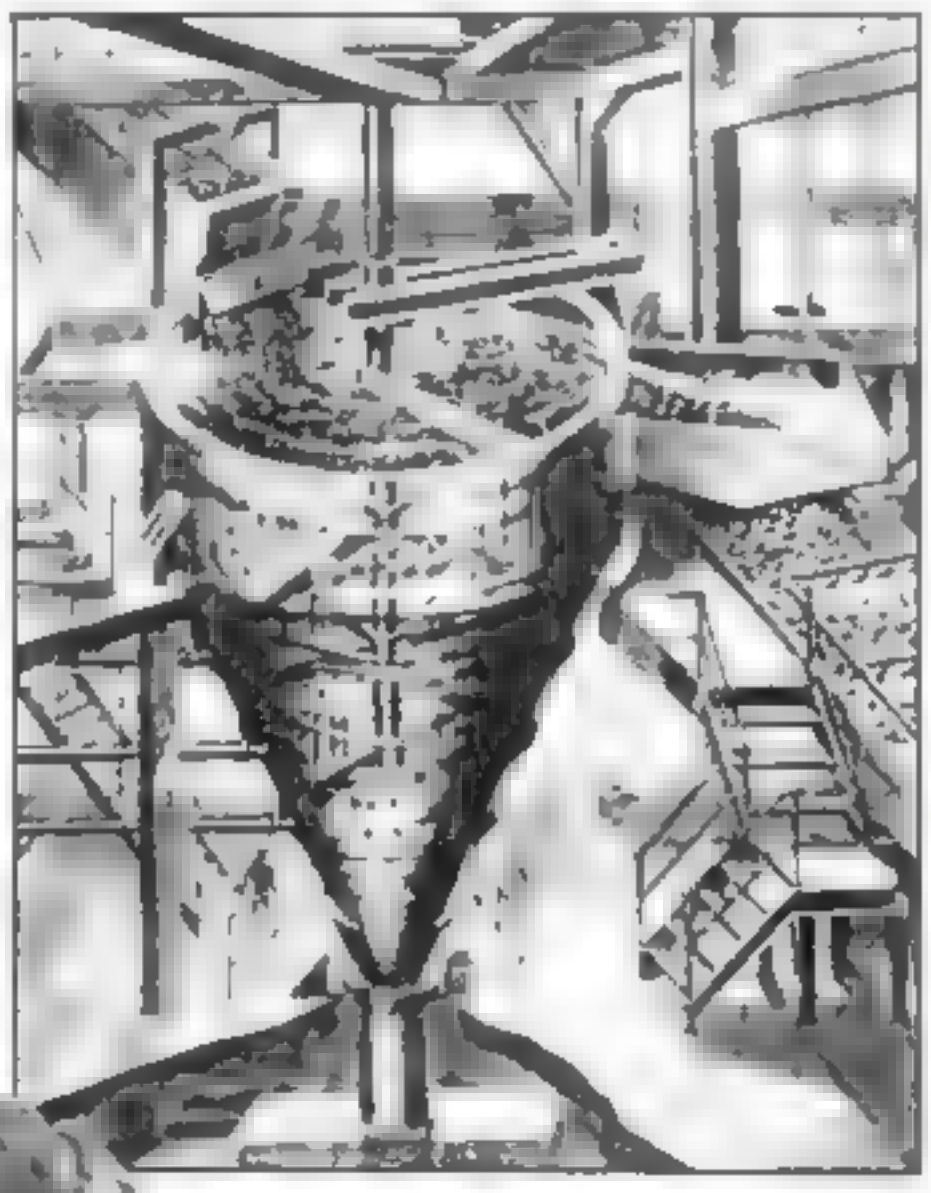


Courtesy American Braille Press

A blind person, face covered, can tell when the moving disk approaches unless ears are plugged

HARD COAL NOW WASHED IN HUGE HOPPER

ANTHRACITE coal fresh from the mine now goes a bath in a giant cone. The wet-washing method recently put in use at several of the largest mines is illustrated in the drawing at the right. From a chute at the upper left-hand corner of the picture newly-mined coal slides into the hopper. The cone is filled with sand and water agitated that the coal will float in. Swirled about in this mixture the [illegible] lumps are washed and scoured, and then ejected into a second chute. Meanwhile lumps of slate sink and are drawn off at intervals. The cone is the invention of a Philadelphia engineer.



USE SPRAY GUN TO RE-INK TYPEWRITER RIBBON

OLD typewriter ribbons need not be thrown away because their color is faint according to the manufacturers of a new liquid that is said to renew them. The compound is applied with a spray gun, and it takes but two minutes to treat the entire length of a ribbon.

BAD MONEY PICKED OUT BY AUTOMATIC MACHINE

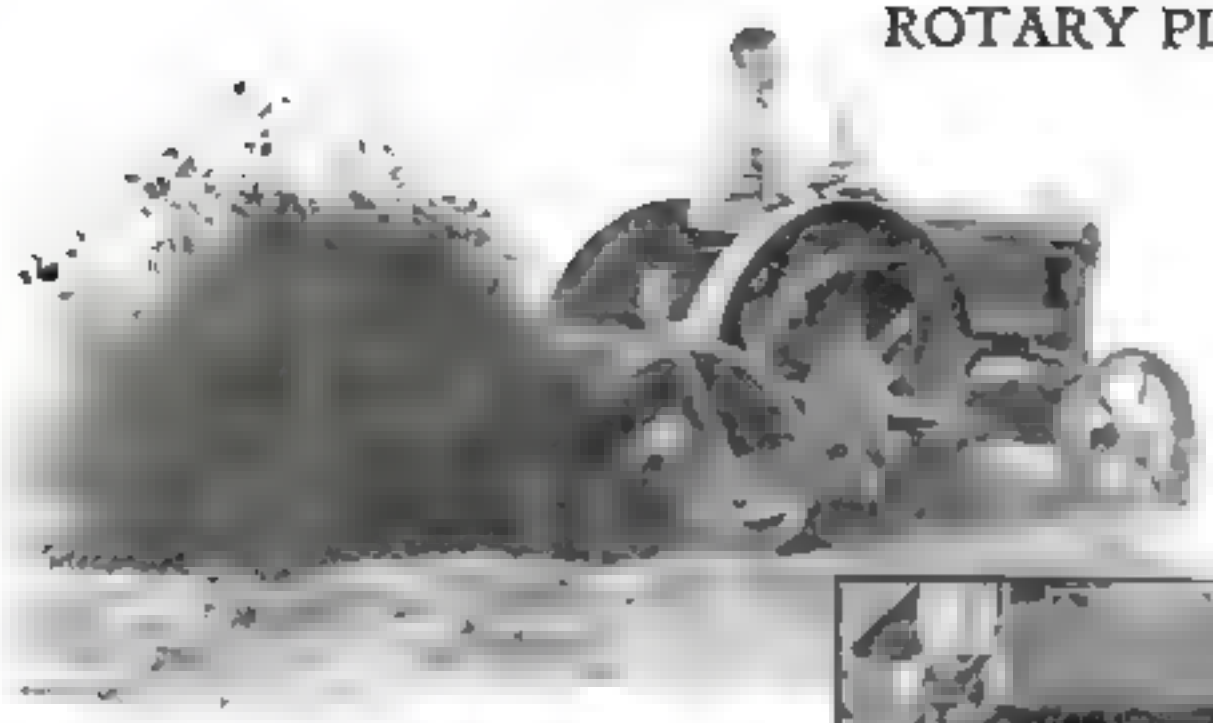
AN ITALIAN inventor has perfected a device that he claims will reveal whether a coin is genuine or counterfeit. When a good coin is inserted in the proper slot and a knob is turned, the money rolls out at the bottom. A bad coin does not reappear. Within the machine devices weigh the coin, measure its diameter, and test it with magnets.

MOTOR WAVES FEATHER FAN

This ostrich plume fan is waved gently by an electric motor

Chantilly lace

ROTARY PLOW PULVERIZES SOIL



Like a dog digging for a bone, a remarkable "rotary plow" demonstrated recently in England throws a stream of pulverized earth into the air behind it. The business end of this new aid to farmers is a revolving cultivator geared to the motor of its tractor frame. As the machine travels across a field, it plows the soil, pulverizes it, aërates it, and cuts any surface growth to pieces, all in one labor-saving operation, thus making unnecessary the use of a tooth drag or a disk harrow.

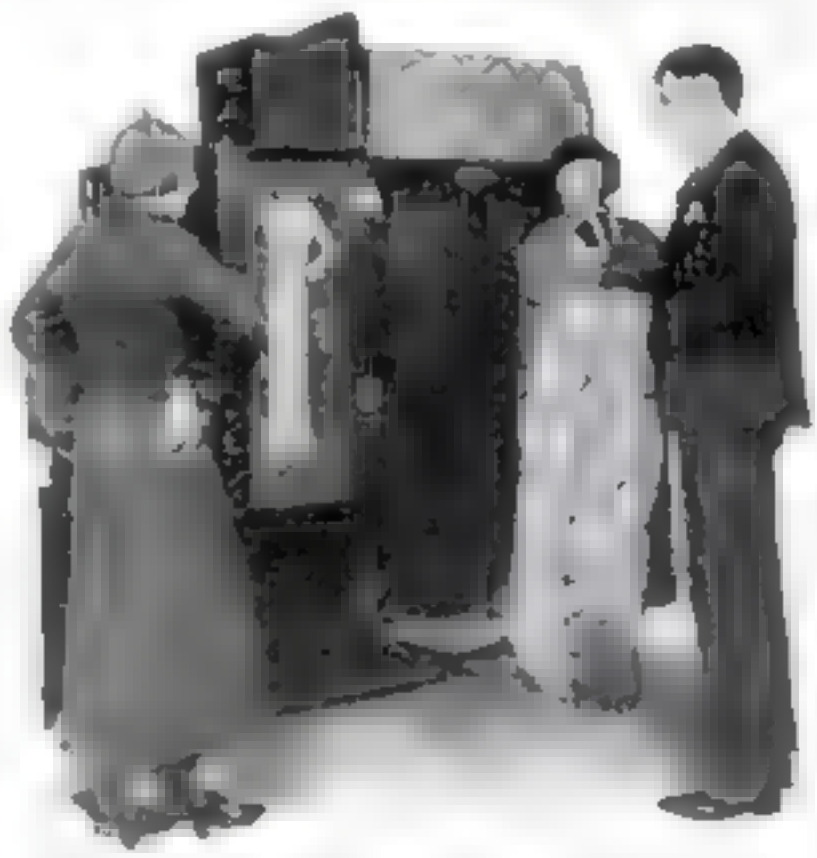
Above, tractor-drawn plow hurling a stream of dirt out behind it, plowing and harrowing being done in one operation. At right, revolving plowing and cutting disks that pulverize soil

WATER COOLER IS ICELESS

The principle of chilling by evaporation, which makes moist skin feel cool, has been applied in an iceless water cooler recently invented for use in warm, dry climates. A glass water vessel holding several gallons is surrounded by a jacket of porous paper, with the lower edge in a basin of water. Acting as a wick, the jacket draws up water and evaporates it. The resulting chilling effect is said to keep the drinking water, during dry weather, thirty degrees below that of the surrounding air. The cooler is a modern adaptation of the *olla* or porous water jar formerly used by western Indians.

MAGIC LANTERN SHOWS FINISHED DRESS BEFORE GOODS IS CUT

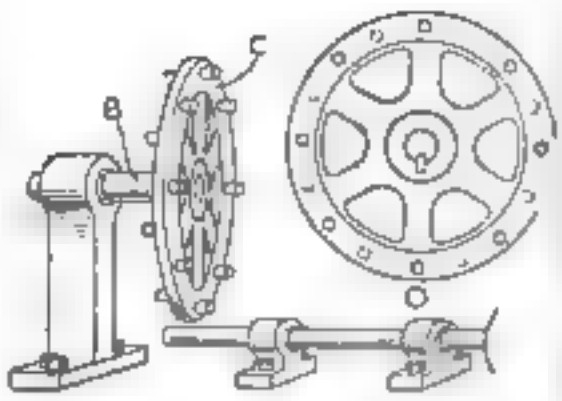
No longer need a woman wonder, when purchasing material for a dress, how it will look when it is made up. A new viewing cabinet, cleverly employing the principle of the magic lantern, enables her to see the finished dress in any number of materials she may choose. The machine is provided with a series of lantern slides, which bear the outlines of dress patterns in current styles. A customer selects the pattern she prefers, and this is inserted in a projection lantern at the side of the cabinet. At the other side, bolts of dress material may be inserted. Mirrors within the cabinet combine the outline of the pattern with the design of the goods and the customer sees an image of the finished dress. She may experiment with any number of materials before choosing and buying the goods. The first of the new machines was recently placed in service in a large eastern store.



Mirrors in magic lantern throw image of dress on screen so customer can see how material will look when made up

POUR COMPOUND IN CAR DENTS

"Plastic surgery" for battered automobile bodies has been made possible by the discovery of a metallic compound suitable for filling dents. The new method obviates the need for hammering out the dents from the inside. Instead, the plastic compound is made workable by the low heat of a torch and is spread evenly into the dent with blocks of wood. It may be applied to vertical parts without running.



Can You Invent It?

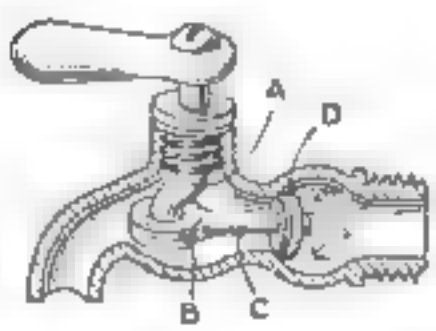
It is required to transmit motion from the shaft *A* to the shaft *B*, at the same time reducing the number of the revolutions per minute. Shaft *B* must rotate only a fraction as rapidly as shaft *A*. Note carefully that the wheel *C* is provided with sixteen pins, projecting alternately from opposite sides of the rim. The edge of the wheel *C* clears the shaft *A* by an amount less than the thickness of one of the pins.

Can you design a part, to be keyed upon the shaft *A*, which will transmit the motion by means of the sixteen pins, and which will operate equally well with the shaft *A* rotating in either direction?

* * *

Here is the solution of the springless water faucet problem of last month.

The stem *A* is bent out of line and then continues a short distance parallel to its original direction. Its end then fits into a ring *B*, connected by a short rod *C* to a disk valve *D*, seating against a constricted part of the faucet. The water pressure upon the disk *D* keeps the faucet closed except when the handle is turned. Then the leverage of the short crank bent into *A* unseats the valve against the water pressure and allows water to run through the faucet. When the handle is released the water pressure instantly closes the valve and the rod and ring restore the handle to its original position without the need of a spring.



Study of this drawing and text immediately above it will give solution of last month's problem

AIR FROM CAR'S TIRE RUNS SPRAY GUN

Air pressure from one of the tires of an automobile operates a midget spray gun that has just appeared on the market. It enables a fastidious car owner to touch up a scratched fender or a rusted spot on the body without need of recourse to bulky apparatus. Cans of enamel are furnished with screw threads to fit the gun, so that there is no waste or mess in filling a reservoir. To avoid possibility of diminishing the air in a tire to below minimum operating pressure, a spare tire may be used to supply the air to the spray gun.

TWO TUBES IN ONE

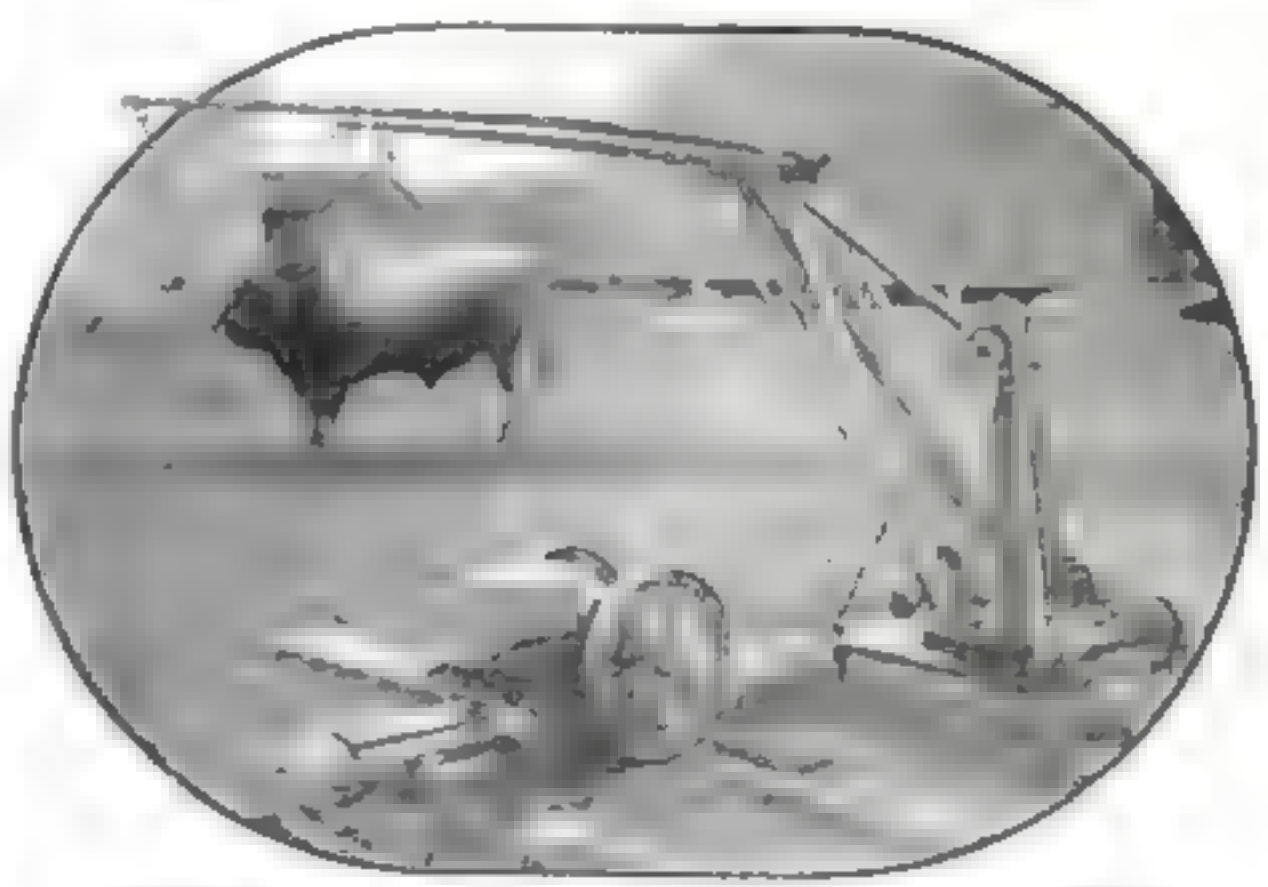
Two radio tubes are combined in one by a new bulb designed for alternating-current sets. Its elements perform the double function of detector and power tube. According to the manufacturer, it makes possible the design of radio receivers using from two to four tubes less than at present.

BIT CUTS SQUARE HOLE WITH ORDINARY BRACE

Square holes may be drilled with an ordinary brace, through the use of an ingenious new device consisting of a special bit and a steel guide. The latter, a flat plate with a square aperture, is fastened to the work. Then the tool's triangular bit removes the wood within the aperture as it revolves.

MACHINE LEADS BULL AROUND BY THE NOSE

A machine that takes a bull by the nose and gives him healthful exercise, willingly or unwillingly, is the novel invention of a Beavertown, Ore., breeder of livestock. Driven by a half-horsepower gasoline motor, the long leading arm walks the animal halfway around a circle, reversing at the completion of the arc. The device is entirely automatic.

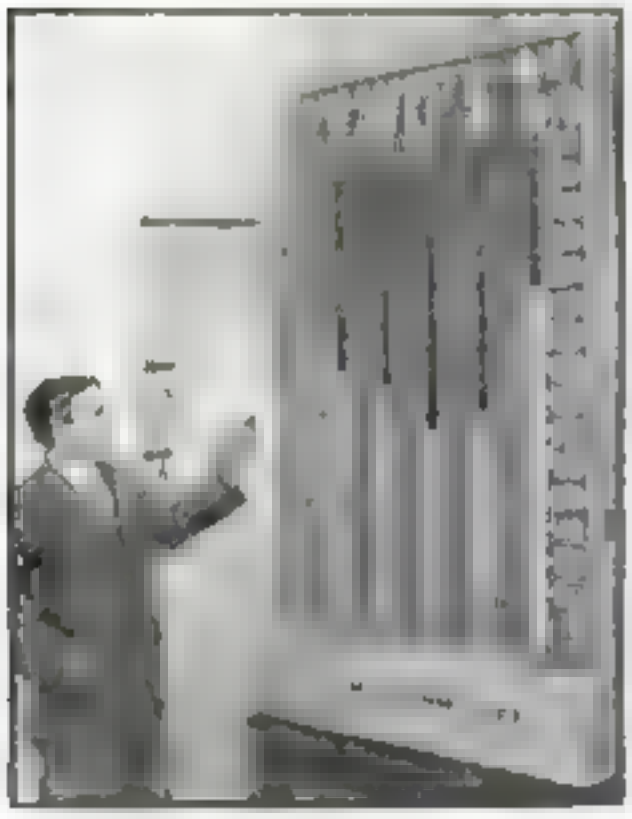


Operated by a gasoline motor, this machine leads bull around to give animal exercise

New Bulb Gives Brilliant Light for Home Movie Makers

Photoflood light, plugged into home socket, gives brilliant light for amateur movie maker

SINCE the invention of the "photoflash lamp," which provided amateur photographers with a handy form of flashlight in a lamp bulb for still pictures, a need has been felt for a steady light for home movies. Now it is announced that a "photoflood lamp" for amateur movie makers has been perfected. It looks like an ordinary frosted sixty-watt bulb, but when it is screwed into a household socket it gives an extremely brilliant light equal to 250 watts of ordinary bulbs and suitable for motion picture photography



AT WAVE OF HAND CHART GIVES COST OF LIGHT

WHEN an electric light user want find out how much light he gets for money with bulbs of different voltage from that on which they are designed to run, he has but to wave his hand at an animated chart exhibited in New York City. An electric eye detects his motion and actuates a series of white mercury columns that rise like thermometer columns on the chart.

The white lines indicate the relation between the voltage, the amount of current consumed in watts, the amount of light obtained in candlepower, and the cost per candlepower. As the chart shows, the light user gets most for his money when the voltage on the bulb corresponds with that of his power supply

PHONOGRAPH IN TINY CASE

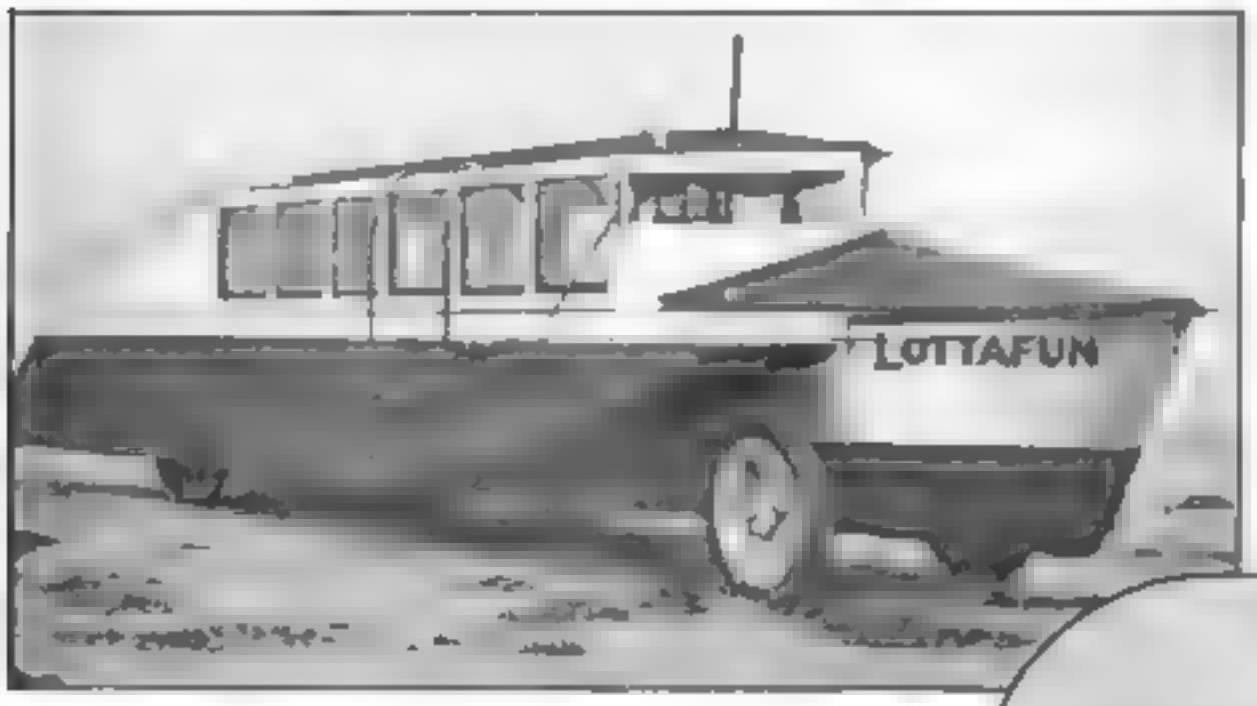
GEARLESS ELECTRIC CLOCK CAN RUN FOREVER

Gearless electric clock has no parts to wear and might be wound to run a month forever. Box supports light bulb and condenser producing rotating magnetic field. A right clock with a accurate

SO FREE of wear that it could run practically forever is a new gearless clock operated by electricity. Its "slow motion" motor has no visible connection to the hands. The secret of the mystery clock's operation is a magnetic linking between the stationary part, a wire-wound circle of iron and a series of concentric moving rings, three of which carry the hands.

A special wiring circuit causes a magnetic field to travel around the wired circle at the rate of sixty revolutions a second, turning the largest of the concentric rings. This in turn drives the next smaller one by similar magnetic linking. Through an ingenious system of gear-like projections that transfer the magnetic force, there is a certain definite amount of lost motion or "slipping" and the rings bearing the second, minute and hour hands rotate at exactly correct speed ratio.

STRANGE NEW AUTO-BOAT MAY RIDE SURF TO SAVE LIVES



Twenty-four-foot land and water craft that has wheels and a boat body. At right the amphibian climbs

UNDER construction near an Oregon beach are several of the strangest of amphibian craft ever designed. With wheels like an automobile but a hull and paddle wheels like a boat, the thirty-six-foot vehicles will be able to run along the beach or dash straight through the breakers. The possibility of their [illegible] has been forecast since they could venture into places where no rowboat could go. With two men aboard such a craft could go to the rescue of a crew aboard a sinking ship.

Last summer the inventor, M. E. Howe, employed a smaller working model of his queer craft as an amusement device. This twenty-four-foot amphibian took eight persons at a time on a thrilling ride in the surf. This model, powered with an automobile motor, could travel at four miles an hour in the water, but marine engines in the new craft will give them fifteen-mile speed. They are expected to be placed in service at various points along the Pacific coast. Special housing, encasing the axle of the auto wheels, render it water-tight without interfering with steering gear.

BALLOON TIRES SILENCE BOSTON MILK WAGONS

BOSTON'S campaign to eliminate unnecessary street noises has just brought in the balloon-tired milk wagon whose fleets of which will soon cruise the city in the small hours of the morning. Outwardly the new milk wagon appears to have the same delivery body as of old, but its chassis closely resembles that of the most modern auto truck, with disk wheels, large pneumatic tires, and approved-type roller bearings for all rotating parts. The new wagon is sponsored by one of the largest dairy firms in the city.

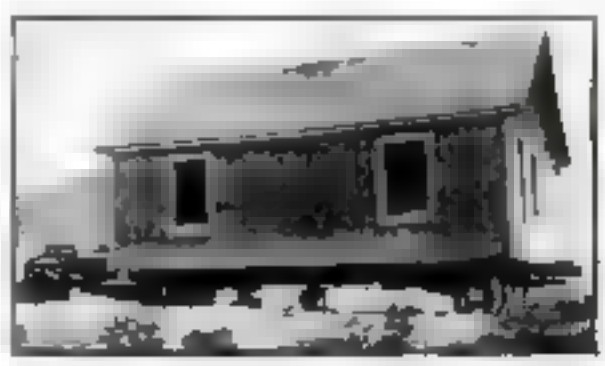
Cushioned shoes for the horses and rubber pads on the bottoms of milk bottles have been used elsewhere for abatement of early morning racket by the milkmen.

[illegible] the hard pavements

HOUSEHOLDS ON WHEELS FLEE GAS FROM MINE

POISON gas from the depths of the earth has just routed the entire populace of a thriving little Wyoming mining town, giving rise to one of the strangest dramas of the modern West. Not long ago noxious fumes were found escaping from the mines of Cumberland, Wyo. With the lives of the four hundred inhabitants being snuffed out at the rate of one a month by the gas, authorities ordered the evacuation of the village. Many householders abandoned their homes and fled. A number of others loaded their frame dwellings on trucks and carted them bodily away to near-by Wyoming cities.

At this writing Cumberland is virtually another of the West's "Ghost Villages."



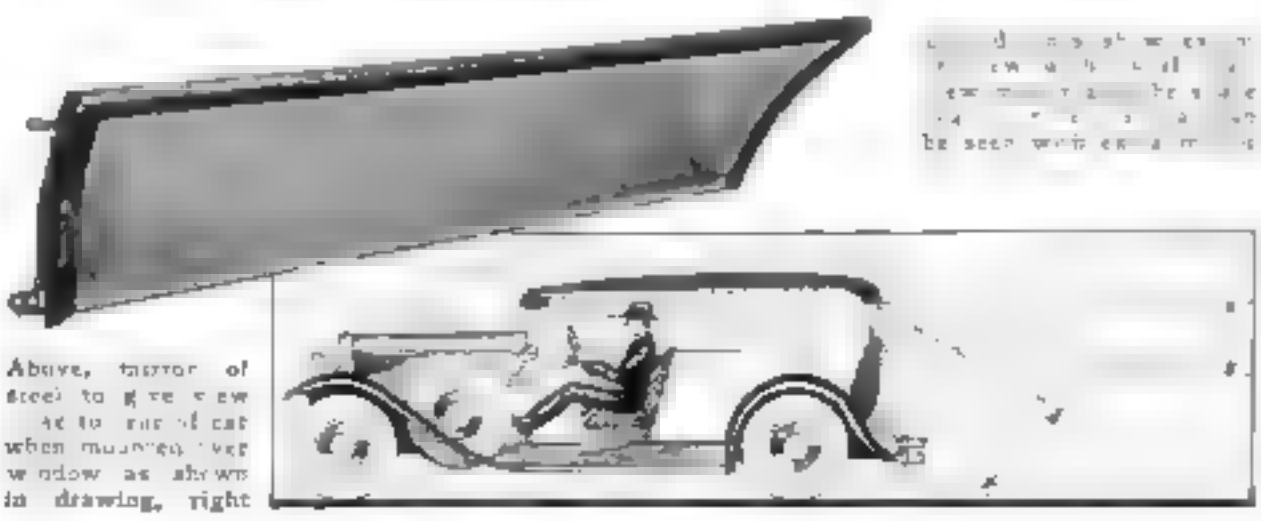
Fleeing poison gas from a mine, residents of a Wyoming town put houses on wheels

REAR MIRROR AIDS IN BACKING CAR

TO AVERT accidents in backing out of driveways or along curbs, a Cleveland Heights, Ohio, inventor has devised an auxiliary rear-view mirror for automobiles. This consists of a curved sheet of polished steel in a neat frame, mounted at the proper angle inside the car just above the rear window. Thus it gives the driver a clear view of the ground directly in back of his car. With the "ground-view mirror," there is little danger of running down a child standing behind the car, or backing into a hydrant.

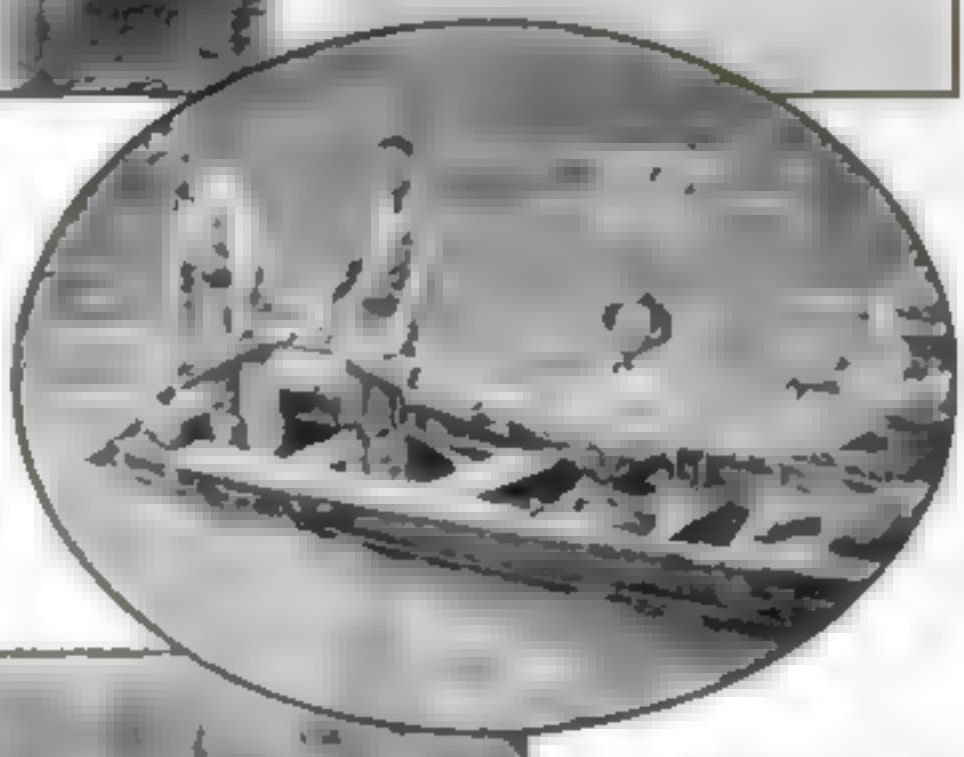
The rear mirror is so set as to reflect [illegible] image into the conventional front mirror, where it is seen by the driver.

[illegible] be seen with [illegible]

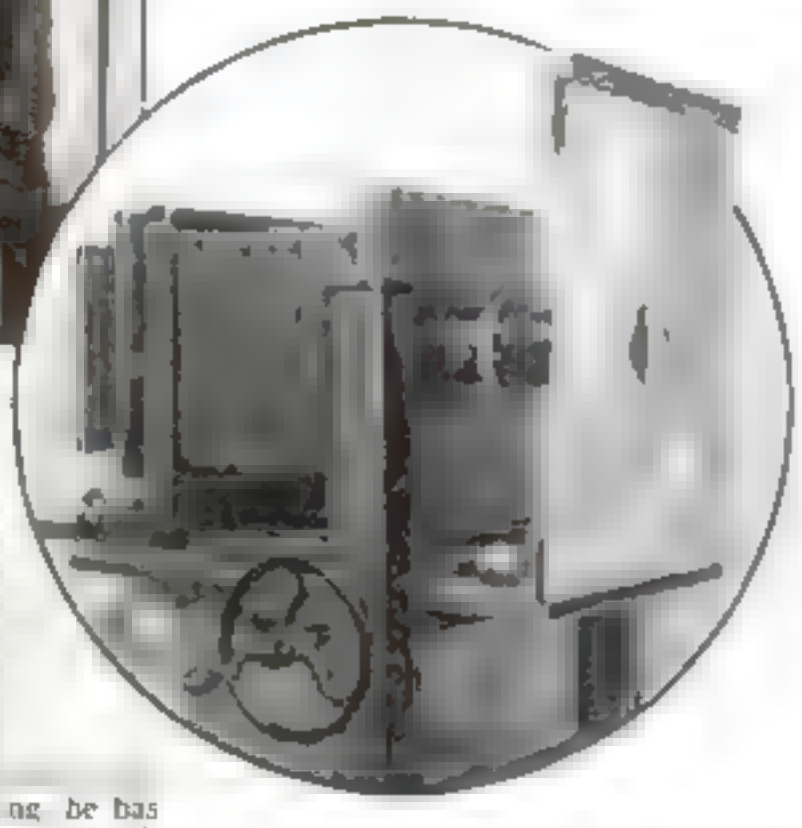


Above, mirror of steel to give view at rear of car when mounted over window as shown in drawing, right

DYNAMITE DIGS TRENCH FOR PIPES IN RIVER'S BED



MIRROR LETS YOU POSE YOUR OWN PICTURE



If the picture is not to his liking he has only himself to blame. The camera, with its lens peering through the mirror, records exactly what the sitter sees

Mirror with opening for lens is set up in front of camera so sitter can see exactly how the finished photograph will look

GUN KNOCKS OUT VICTIM WITHOUT WOUNDING HIM

Gun contains a powder that explodes with a knock-out air shock when trigger is pulled

AMAZING MOTOR-DRIVEN HOOP MAY BE CAR OF THE FUTURE

Above, Dr. J. H. Purves, Englishman, [illegible] he unicycle, with a model [illegible] At [illegible] while [illegible] passenger

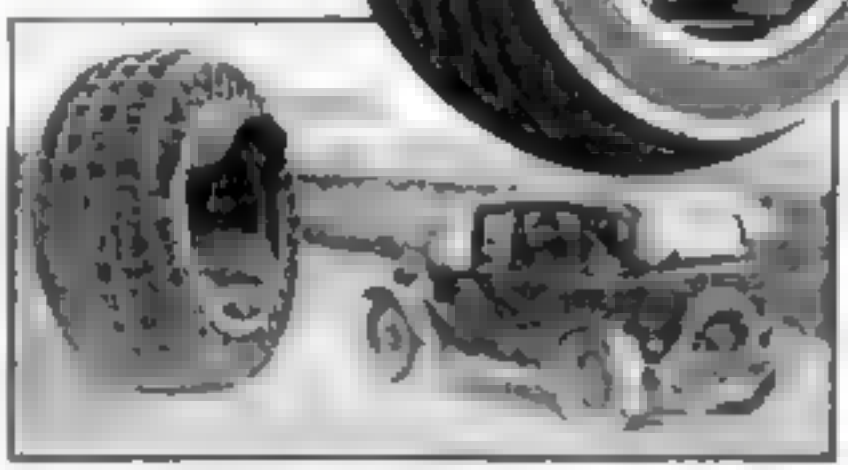
In the unicycle, the [illegible] the wheel which revolves [illegible] by [illegible] ride. Photo shows [illegible] driving the car

A TEN-FOOT hoop of iron [illegible] clickety-clacks along an English highway. Passing motorists slow down and pause to peer at the apparition. The man inside it is driving as unconcernedly as if he were out for a Sunday ride.

Later the same strange hoop is put through its paces on the beach at Brean Sands, near Weston-Super-Mare, England, before a crowd of spectators. With a speed that is astonishing in view of its ungainly appearance, the wheel goes spinning along the sands at a thirty-mile-an-hour clip. When it has come to a stop, the driver and inventor, Dr. J. H. Purves, steps from it and declares he has just demonstrated an experimental model of the high-speed vehicle of the future. By substituting one wheel for the four wheels of the conventional automobile, he maintains that he has reduced locomotion to the simplest possible form, with consequent economy of power. The motor, remaining upright on a roller-mounted carriage with the driver's seat, transmits its power to the inner rim of the hoop.

Witnesses of this extraordinary demonstration, which took place recently, saw that a gasoline motor of only two-and-a-half horsepower was sufficient to run the thousand-pound wheel. Another smaller motor hoop was demonstrated, run by electricity. At present the machines are admittedly crude, the driver steering, for example, by leaning to one side and thus tipping the wheel slightly toward the direction in which he wishes to go. Dr. Purves exhibits a working model to [illegible] the one-wheeled vehicle that he visions on future highways.

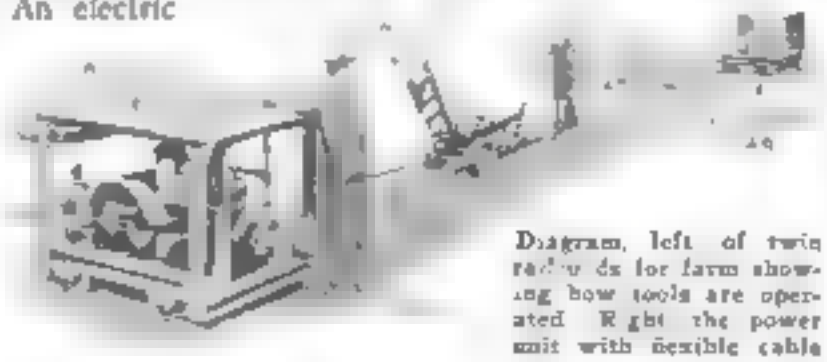
In this "dynasphere," as he calls it, passengers will sit within an inclosed cabin that remains upright while the tread revolves around it. The tread's curved surface has the shape of a section cut from a sphere. To steer the vehicle the driver operates gears that shift the cabin to one side or the other, tipping the wheel and thus directing its course.



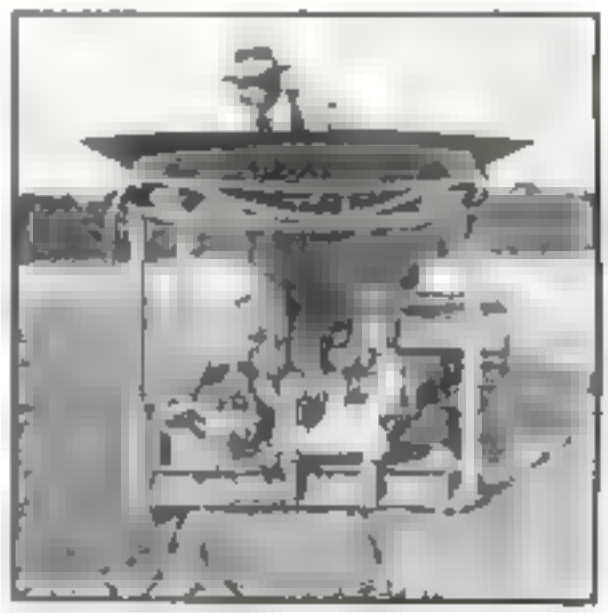
Present and future? The unicycle meets an auto on the highway

USE RAILROADS TO DO FARM WORK

MINIATURE railroads to aid farmers in doing their plowing and cultivating by electricity are an innovation tried out successfully in France. How they replace horse- or tractor-drawn tools is shown in the accompanying diagram. An electric power unit driven by a five-horsepower motor and a weighted car travel on parallel tracks. Between them a plow or other tool travels back and forth on cables between the two cars, the power being applied through pulleys. The speed of the tools may be varied at the will of the operator. It also serves many auxiliary purposes, for fire-fighting apparatus, conveyors, and wood-sawing tools are among the things that can be operated from the railway.



Diagram, left, of twin railroads for farm showing how tools are operated. Right, the power unit with flexible cable



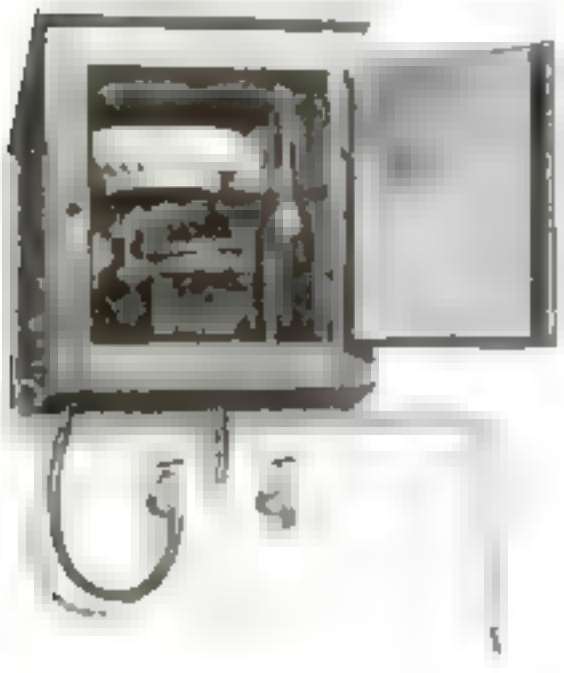
· *Practical New* Home

JUICE CAN'T SQUIRT. Slices of lemon, gripped between the jaws of this flexible squeezer, are held firmly by the sharp projections and then a little pressure on the end grips forces the juice out and into the cup

NO STALE COFFEE Closing this aluminum coffee container hermetically seals it with the heavy lid which has a pad of special rubber compound on spring rim. Thus air is excluded and no canned odor is produced in the coffee which, it is said, will remain fresh indefinitely if stored in this can

ROLL THE TEETH CLEAN. A new type of hygienic toothbrush is rolled against the teeth for the purpose of cleaning and removing the film. There are no bristles in the brush, which the manufacturer claims makes it impossible to injure tender gums

WEATHER MAKING UNIT. Homes and private offices can now be supplied with an air conditioning outfit, designed to give any desired temperature and at the same time moisten or dry the air and cleanse it of dust and disease producing germs. Fans deflect and diffuse the air throughout the room. Walnut or mahogany cover the weather unit which can be used, as photograph above shows, for quick drying of laundry



FOOD CHEST ON SINK A piece of rubber hose connects this cabinet with the water faucet at the sink and whenever the water is turned on, it circulates through pipes within the insulated chest the internal temperature of which is thus held at the temperature of the water from "cold" tap

MEASURE YOUR SUGAR. This sugar bowl does away with the need for using a spoon as each time it is tilted exactly a teaspoonful of sugar is released and flows out. Also, according to its maker, it has the advantage of keeping the sugar safe in a closed sanitary dish

ENJOY CORN ON COB. Roasting ears are served in this covered dish, shaped to fit the ear and provided with skewers that are stuck into the ends of the cob. Revolving the ear spreads the butter and the dish keeps corn hot

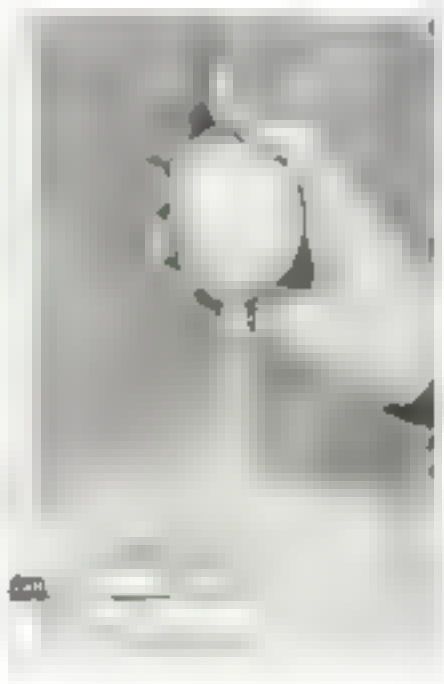
SKEWERS FOR BAKING. Made of aluminum, the skewers, right, are stuck into the potato, apple, or meat to be baked and then stood in the oven. The skewer conducts heat to the inside of the food, thus insuring even cooking

Utilities

MILK BOTTLE GETS ALUMINUM CAP

To preserve bottled milk from contamination and to guard against tampering, aluminum caps are forced ec· ho it

HOLDER FOR SOAP CHIPS. Into th a ed container the soap chips box fits chips come out through the spout It an attractive and sanitary soap holder



NO DRY LEMONS. A perforated aluminum tube is forced through a lemon and slight pressure then releases the juice. If pulp clogs the tube, the wooden rod is used to force it out. Lemon with tube in can will not dry out and spoil while it is stored in the refrigerator

TAIL HOLDS DUST

ICE KEEPS ROOM COOL. This polar ice tank holds about 25 pounds of ice. Connected to light socket, the current driven fans that expel the cooled air

NO GLASS NEEDED This pocket sized jet can fit attaches to the faucet in your home and if turned up, the water bubbles out like a drinking fountain. Turned down it is a regular faucet

BREAK YOUR CAKE. If you feel that cake should be broken and not cut, the tool shown at left will interest you. It has teeth that break hot cake without crumbling

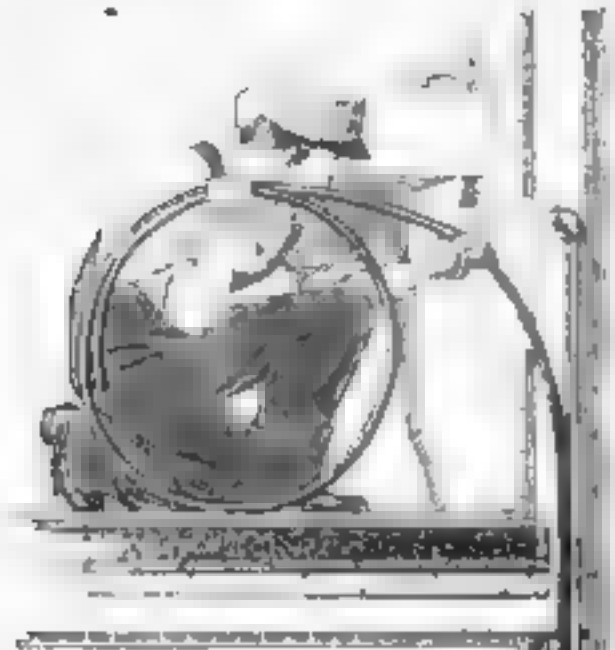
CLOCK ON LIGHT SWITCH Each room in your home can now have an electric clock which can be installed on the regular electric wiring without interfering with the use of current for lights. An alarm is provided for these new clocks

Keep Your House NEW

and Escape Big Repair Bills

Systematic Vigilance Necessary to Reduce Wear and Tear—Here Are the Danger Spots You Must Watch to Safeguard Your Dwelling

By R. W. SEXTON



Seasonal Checking List

FOR KEEPING YOUR HOUSE FIT

Spring:
- Clean boiler and furnace
- Remove smoke pipe
- Paint outside
- Repair screens

Summer:
- Examine roof
- Clean traps
- Make windows tight

Fall:
- Clean gutters
- Inspect drainage system
- Replace smoke pipe

Winter
- Paint inside
- Inspect floors
- Clean traps

TEARING OUT WALLS NOW UNNECESSARY IN REPAIRING PIPES

Flexible copper pipe as shown here, can be used now in replacing old pipes without demolishing the walls, as the copper pipe will bend at the turns where formerly elbow joints were installed. Thus the new pipe can be passed through a hole cut at only one point

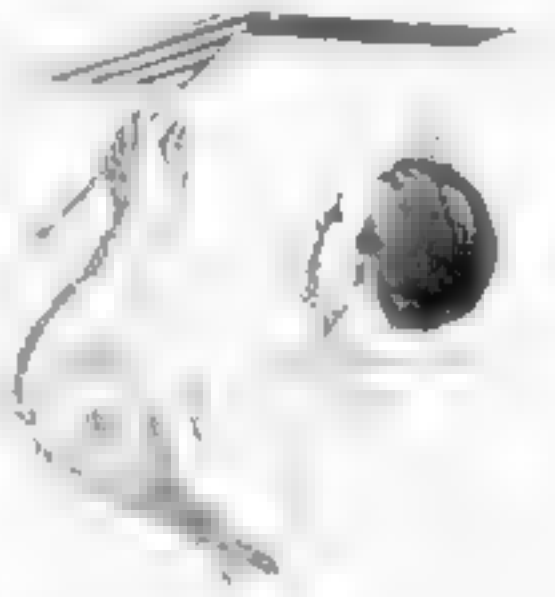
HOUSES, like clothes, are subject to wear and tear. We all know that the "stitch in time" makes a coat last longer, and our experience with automobiles has taught us the wisdom of keeping them in perfect repair. A house, unlike a car, will run in spite of worn spots and damaged parts. As a result some house owners find it hard to realize that they can save money by making repairs the instant repairs are needed. This job," they say, "is too small to need immediate attention," and while they delay the damaged area spreads by leaps and bounds.

Suppose some morning you see a wet spot on the living room ceiling. It is a mere nothing, for there is just a drop or two of water on the floor beneath the radiator in the room above. You decide it would be silly to call a plumber for such a trifle. Probably you do not realize that it had to be a fair sized leak before the water would get through the floor, the under-flooring, the lath, and plaster and show on the ceiling below. You forget that even a little water inside a wall or floor can do a lot of damage.

This tiny leak at which you scoff actually may be serious or may very quickly become so. You cannot be sure it is not a bad leak, since you have no way of knowing how much water may have found its way beneath the floor boards. That is why you should call the plumber at the first sign of a leak. If you wait, the water has time to spread, a large portion of the plaster in the living room may become loose, and the water, trickling into the wall, may damage the wall paper.

Repairs necessitated by a leak of this kind can be done much easier now than they could have been done several years ago. It is a disagreeable and messy job to work with plaster. However, there are materials on the market now that make a patching job simple and clean. First all the loose plaster must be removed. Then a piece of wall board, cut to fit the hole, is nailed to the lath and the joint between the wall board and the old plaster filled with "patching plaster," which can be bought at any hardware store and is easily applied with a flat piece of metal. Finally a coat of plastic paint will completely hide the patch. The paint can be applied with a brush and the desired finish may be obtained by using a stipple brush, a sponge, or a wad of crumpled newspaper. If the wall paper is damaged, repairs may be made in the same way and new paper hung. If the entire plaster wall or ceiling must come down, wall board can be used instead of plaster, saving a great deal of inconvenience and dirt. The joints between the boards, however, should always be pointed up before painting or hanging wall paper.

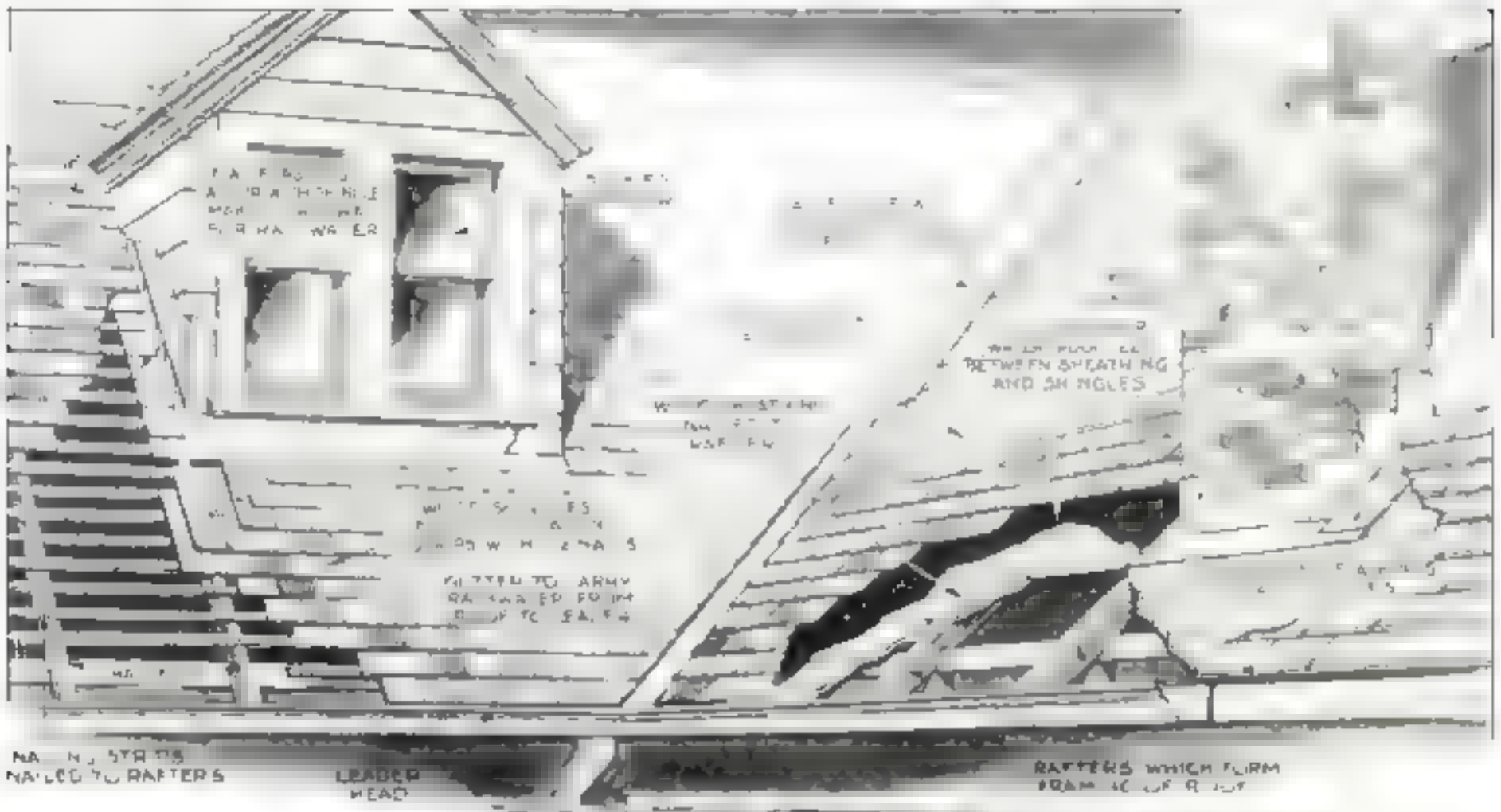
Probably seventy-five percent of all repairs are made necessary by the action of water. Roofs, even though constructed of first-class materials, sooner or later may start to leak. The gutters that run down the sloping roof to the leaders, and the leaders themselves, will, in time, show worn spots and cause trouble. Unless your walls are properly damp-proofed, rain



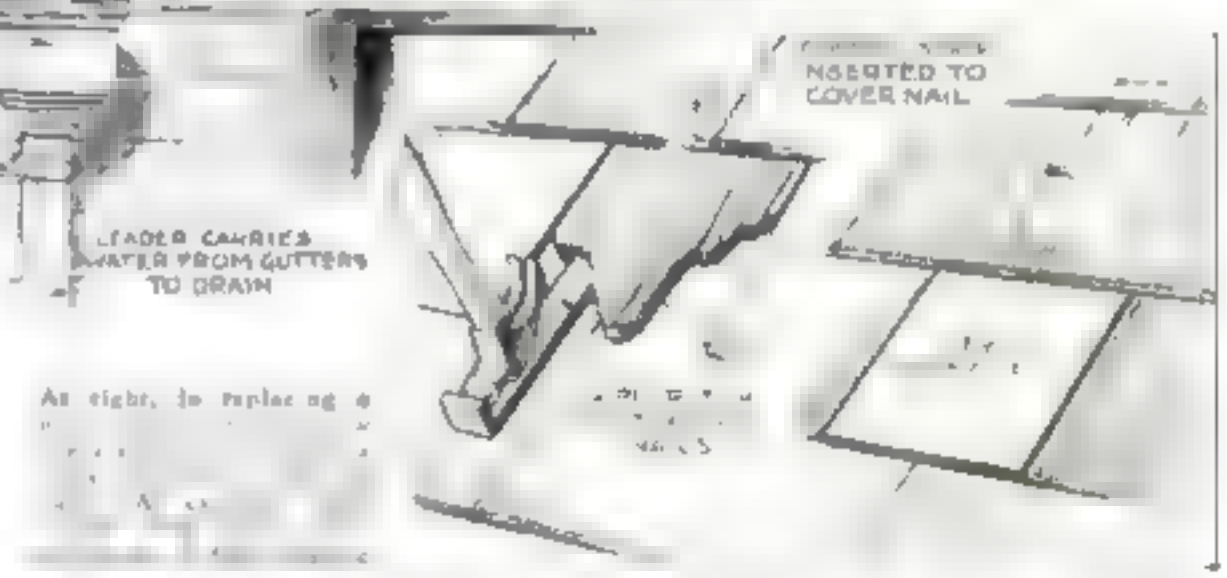
When plaster ceiling is pulled down in making repairs, it can be replaced with wall board, thus saving much inconvenience and dirt

water, seeping into the ground, may eventually find its way into the cellar. It is wise, therefore, occasionally to inspect these various details to see that they are holding up under normal wear and tear. The gutters should be cleaned out in the fall so that ice will not form in them and cause the metal to deteriorate.

If there is an attic in your house, or a little-used storage space below the roof, it is well to go up there once in a while to see that the roof is not leaking. A leak in a wood-shingled roof is easy to remedy if attended to at the proper time. Shingles are laid so that they overlap and the joint between two shingles is thus always protected by a third shingle. Sometimes during a prolonged dry spell shrinkage opens these joints. When it rains, water may



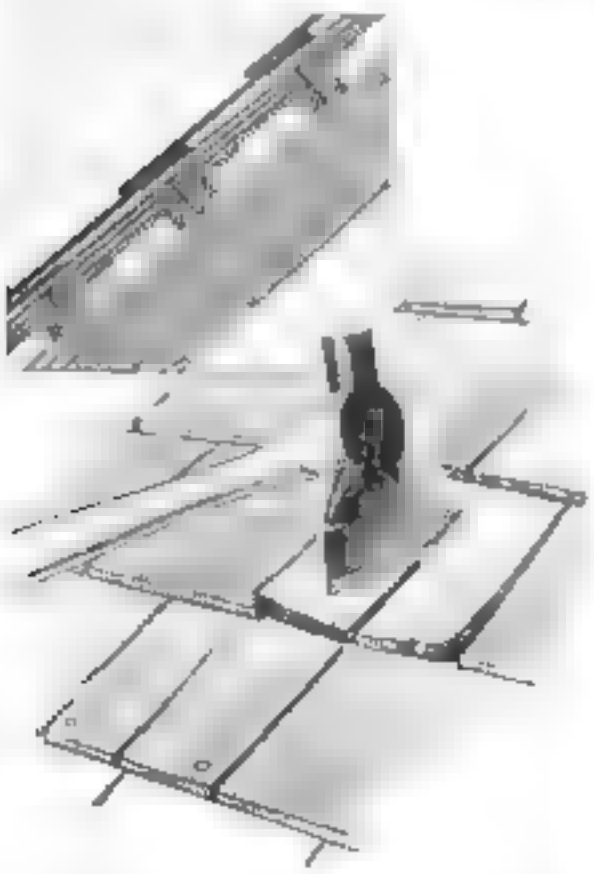
Drawing shows proper manner of [illegible] how shingles at [illegible]



At right, in replacing a [illegible]

leak in before the shingles have time to swell, or a shingle may crack and allow the water to seep in. Since these cracks generally are visible, it is possible to locate the damaged shingles and replace them with new ones, or a piece of metal may be slipped under the defective shingle if the crack is not too large.

When replacing a worn shingle with a new one, it is sometimes difficult to get the old shingle out. There are special tools called rippers made for this purpose. When inserting the new shingle, never nail through the exposed surface. Instead, drive the nail between two shingles, in the course above, and then slip a piece of copper under these two overlaying shingles so that it covers the head of the nail and extends under the next course above.



In preparing an old roof for reshingling it is desirable to split all warped shingles with a hatchet and then nail them down securely

Usually wood shingles are nailed to strips of wood that run horizontally over the outside of the rafters. This allows a free circulation of the air that dries the shingles after a rain. Where slate or composition shingles like those made on an asbestos or asphalt base are used, the roof is first inclosed with sheathing boards nailed to the outside of the rafters. Slate and composition shingles, nailed directly to the sheathing, are laid in much the same manner as wood shingles. To lessen the chance of water getting in back of the shingles, roofing paper is laid between the slate or composition shingles and the sheathing. Repairs to damaged slate or composition shingles may be made just as in the case of a wood-shingled roof.

It is possible to prolong the life of a wood-shingled roof by occasionally applying a coat of asphalt paint. A waterproof cement may be used on a slate roof to repair minor imperfections. If, however, the shingles have so deteriorated that a new roof must be laid, it is not always necessary to remove the old shingles before laying the new ones. In preparing the old roof for reroofing, it is desirable to split all warped shingles with a hatchet and nail them down tight. If slate or composition shingles are to be used for the new roof, they may be nailed directly to the old roof. But if the new roof is to be of wood shingles, it is best to apply nailing strips to the old roof and nail the new shingles to these strips. The nailing strips may be pieces of wood about one by two inches. They are usually placed so that there are three or four nailing strips to the length of each shingle.

Sometimes a leak in the roof, not due to the shingles, is caused by a defect in the flashing which is a technical term for the metal work used to make the joints waterproof. For example, it would be impossible to get a tight joint where wood shingles meet a brick chimney. To take care of this, pieces of flat copper or zinc, about the width of the shingles, are placed beneath the shingles with enough of the metal extended to form a right angle where it meets the chimney. Similarly, other pieces of metal, preferably the same metal and the same size, are inserted into the brickwork of the chimney, and, where they extend, they are bent at right angles downward, overlapping the other metal pieces. These pieces of metal deteriorate in time, the joints open, and water may get inside. These open joints may be stopped *(Continued on page 126)*

Making a Chemical Harmonica

• *Fascinating Hydrogen Experiments to Perform in the Home Laboratory*

By
Raymond B. Wailes

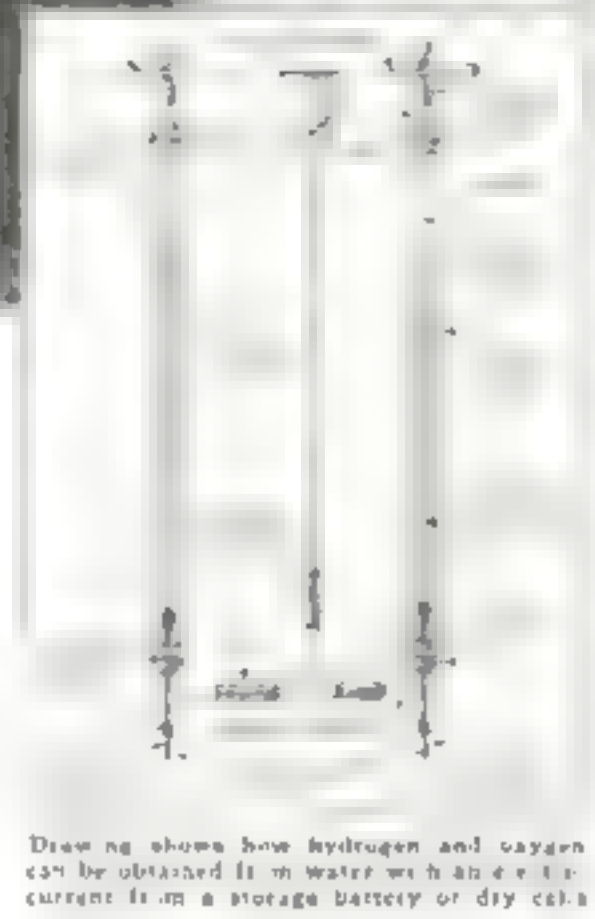
MINIATURE harmless explosions, lighter-than-air soap bubbles, and a singing flame are some of the possibilities in experimenting with hydrogen gas.

Perhaps the easiest way for the home chemist to make hydrogen gas is to heat pieces of aluminum metal in a tablespoonful of lye dissolved in a cup of water. A chemical flask is a suitable vessel in which to make the gas. A strong steady flow of hydrogen being produced with this method.

As you know, hydrogen gas burns, forming water. To demonstrate this, hold a cool glass or beaker above the burning hydrogen gas escaping from the generating flask and a dewy surface will form on the inside of the glass or beaker. To prove that the dew, or water, did not come from the water in the flask, you may affix a drying tube containing calcium chloride lumps, or dry lumps of lime, to the exit of the flask.

The drying tube can be made from a broken test tube and should be fitted with corks bored to take a glass elbow and a medicine dropper. The calcium chloride abstracts the water vapor from the hydrogen gas. The hydrogen gas should be lit from the end of the dropper, after allowing the air inside the generating flask to escape for about a minute before applying a flame.

If the medicine dropper is turned so that the flame is pointing upright, and a glass or metal tube about half an inch in diameter is held so that the flame burns within it, a musical tone will be heard. This often becomes very loud. The whole device has been called a "chemical harmonica."



Drawing shows how hydrogen and oxygen can be obtained from water with an electric current from a storage battery or dry cells.

The issuing hydrogen gas can be led into soapy water to produce bubbles that float up into the air. An inverted test tube held over the end of the medicine dropper will become filled with hydrogen gas, and the gas, being lighter than air, will pass upward into the tube. If the finger is placed on the mouth of the tube, held upright, and a match applied, a flame accompanied by a small, harmless explosion will take place, as the mixing of the air with the hydrogen forms a compound that is explosive.

HYDROGEN gas can also be made by allowing an acid to act upon iron or zinc. Heating equal parts of sal ammoniac and sodium bisulphate in water with pieces of iron, such as tacks or nails, will also produce hydrogen gas. This latter method is convenient and avoids the direct use of the usual acid mixtures. The bisulphate-sal ammoniac-iron mixture will not, however, produce as steady a stream of hydrogen as that obtained from lye water and aluminum metal. Of course in using lye water as described the usual precautions should be taken to prevent the solution from coming in contact with the hands or clothing. Zinc and lye water when heated in a flask, also produce

At left, hydrogen gas coming from flask containing aluminum metal in lye and water gives off clear musical tone when burning in an upright glass tube.

Cool, dry glass over hydrogen flame becomes wet, proving burning hydrogen forms water.

hydrogen gas, although not as readily as aluminum scraps and the lye solution.

If a solution of copper sulphate (bluestone) is swirled about in a flask with zinc dust or zinc powder, the zinc will become coated with copper metal. After five minutes pour off the copper sulphate solution and add water to the copper coated zinc. Then pour this off, and cover the coated zinc with an inch or two of water in a flask. Heat the whole and the copper coated zinc, or copper-zinc couple, as it may be called, will decompose the water, producing hydrogen gas as can be seen by the bubbles. This is another convenient method of producing hydrogen gas for experiments.

WATER can also be made to produce hydrogen gas, and also oxygen gas, by passing an electric current through it. The water should be made slightly acid with some sulphuric acid. The drawing shows gas-producing apparatus that is not difficult to make. Three tee tubes, two glass tubes about a foot long and half an inch in diameter, a thistle or other funnel, some corks, rubber tubing, pinchclamps, and a ringstand support are needed.

The whole apparatus is filled with the acidulated water and the direct current from a storage battery or several dry cells passed through the apparatus by connecting the battery to the lead strips which are sealed into the tee tubes with sealing wax. Twice as much hydrogen as oxygen is produced.

In filling the apparatus, the metal pinchclamps (wooden spring clothespins can be used) on the rubber tubes at the tops of the large gas tubes are removed, and the acidulated water poured into the funnel, which must be higher than the gas tubes. When the entire apparatus is filled with acidulated water, the pinchclamps are screwed down tight. After the current passes for several minutes, the hydrogen gas is obtained from one gas tube by opening the clamp on this tube, and the oxygen gas can be obtained from the other gas tube.

Build Your Own Transformers

Fig. 1. Left hand holds standard type volume control made so that it can be fitted with new design snap switch that takes place of dust cap

RADIO experimenters and the fellows who are delving into other branches of electricity frequently want a supply of alternating current at a voltage lower or higher than the house supply. With alternating current, changing the voltage is simple. All you need is a transformer, and an alternating current transformer appears easy to build. It is just a core made of thin sheets of iron with two coils of wire, one connected to the light circuit and the other supplying current at a different voltage.

However, when you dig into the textbooks to find how to make up a transformer to suit your own particular requirements, you strike a snag. Designing a transformer it seems, is a complicated process involving difficult mathematical formulas.

Much of the mathematics can be eliminated as far as the amateur experimenter is concerned. A transformer plenty good enough for the amateur requirements can be built without going into any calculations beyond the simple relations between volts, amperes, ohms, and watts as given in Ohm's law, which can be found in the first few pages of any elementary book on electricity.

You can substitute rule-of-thumb methods for involved calculations because it probably won't make a pin's worth of difference to you whether the transformer is ninety-five or only eighty-five percent efficient. All you require is electric current at the desired voltage from a transformer that will do the job without undue overheating.

The first rule in designing experimental transformers is to play safe. Make the core a little bigger than necessary, use a few more turns of wire than you think will be required, choose wire a size larger than the wire tables specify for the current which will flow, and don't skimp on insulation, especially between the primary and secondary windings.

In theory, the voltage that will develop at the secondary terminals is directly proportional to the number of turns of wire in the secondary coil, and the relation between the voltage applied to the primary winding and the voltage developed in the secondary also is directly proportional to the ratio between the number of turns of wire in the primary and secondary coils. Thus, if the primary has, say, 500 turns of wire and the secondary has 250 turns of wire, the secondary voltage will be half of 110 or 55 volts. If the secondary had only 50 turns of wire the secondary voltage would be only one-tenth, or 11 volts.

THE number of turns in each coil is inversely proportional to the cross sectional area of the core. If the core measured one inch wide and one inch deep it would have a cross sectional area of one square inch, and so on. A safe figure for amateur design is seven turns of wire per volt for a core area of one square inch if the transformer is to be used for hours at a time or four turns per volt if it is going to be operated only a few minutes at a time.

The core should have at least six square inches cross sectional area if the output is to be a kilowatt and proportionately less for smaller outputs. Don't skimp on core size. A core twice as big as necessary works just as well and heats less.

IN ANY transformer, the voltage applied to the primary multiplied by the current which flows in that coil equals the voltage developed at the secondary multiplied by the current drawn from the secondary. In other words, the wattage of the secondary always equals the wattage of the primary less a certain small percentage which represents the electrical losses.

This relation is useful in determining the proper size of wire to use. Knowing how much current is to flow in the secondary to carry the load you intend to connect to it, you can choose wire sufficiently large for the job.

The most efficient shape for the core is a rectangle with a cross member like a letter "H" closed at top and bottom, with the coil wound around the center section. This is a difficult form for the amateur. The plain, square core with both coils wound around one leg is much easier.

The proper material for transformer cores is the special silicon steel made for the purpose, but soft sheet iron, if carefully annealed, will do.

SIMPLE WAY TO TREAT CORE AND WINDINGS

Fig. 2. Transformer for use in experiments work can be built without use of involved mathematical formulas. Square core, with both coils wound around one leg, is simplest form to give good results

New Panel Layout

BECAUSE of the number of controls, the radio experimenter often has difficulty in arranging a neat looking panel layout. Fig. 1 shows a novel way to get rid of the power switch that turns the set off and on. In the left hand is a standard type volume control, specially designed so that it can be fitted either with the blank dust cap or with a new design of 110-volt switch. The latter, held in the right hand, simply snaps on in place of the plain dust cap. A stud on the moving contact arm of the volume control drops into a forked member of the switch.

The spacing is such that, as the volume control is moved from the "no sound" position, the stud throws the switch on and then moves out of the fork, as the knob is turned to the point at which the volume is right. The switch is of the snap variety with a spring that holds it in the off or on position. To turn the set off, the knob is turned back and the stud reëngages with the fork to throw the switch.

TUBES *for* Special Radio Jobs

By ALFRED P. LANE

Specialization in Radio

Different kinds of electric current and the varying functions of tubes have made worth while the design of special tubes [illegible] do one kind of work supremely well [illegible] more efficient [illegible] expected [illegible]

WHEN you went into a radio store a few years ago and asked for a new tube for your set, the clerk took one from the shelf, tested the filament with a flashlight battery, wrapped it up, and charged you nine, eight, seven, six, or five dollars depending on the date of the transaction.

In those times there were exactly two kinds of radio tubes—good and bad.

Now there are nearly as many types of radio tubes as there are varieties of pickles. From the original three-element general purpose tube invented by De Forest there have been developed many specialized tubes, each designed to perform some particular job with maximum efficiency. In the modern radio receiver the circuit always employs several of these specialized tubes. In fact, the simplest little four-tube set may use three different types of tubes and a nine-tube job as many as five.

Today, when you go to a radio store to replace a burned-out tube, you must know the type number, which is always stamped on the base of the tube no matter what the make. Instead of a crude test such as trying the filament with a flashlight battery, the salesman now plugs the tube into an elaborate test panel fitted with several meters, the pointers move over the scales, the salesman pronounces the tube O. K., and the charge is only a dollar or so

UNLESS you are thoroughly versed in radio matters, the test means nothing to you. As a matter of fact it doesn't mean a great deal to anybody, for even inferior tubes that may not last more than a day can be made to pass those meter tests

Why should so many different kinds of radio tubes be necessary? What need, for example, is there for three varieties of general purpose tubes, four types of screen grid tubes, and so on?

One reason is that there are four different kinds of electric current available for operating radio receivers. The most common is 110-volt alternating current. Some of the big cities still use 110-volt direct current. Thousands of farms still have no central power supply and must depend on batteries. Radio sets mounted in automobiles must use the six-volt current from the starting battery and in addition they must stand severe vibration.

Considering first the present-day general purpose tube, we have the type 227 for use where alternating light current is on tap. Although the appearance of the metallic electrodes inside the glass of this tube is not at all like that of the old 201A, the 227 has about the same electrical characteristics and can be used in the same radio circuit if the filament power circuit is changed over. The 201A has a hairpin shaped filament that is heated by the flow of direct current at five volts. The 227 has a cathode consisting of a tiny metallic tube coated with the electron emitting substance. This cathode is heated by a filament inside the cathode and insulated from it. The current supply to operate the filament must have a pressure of two and one half volts, and as this heating filament plays no part in the radio operation of the tube alternating current can be used. The construction is much like that of an electric soldering iron, where the electric current has no function except to supply heat to the outer shell.

The 237 tube is much like the 227 except that it has a heating filament that operates at six volts. It is for use in automobile sets or in 110-volt direct current outfits. The heaters of all the tubes in the set are connected in series for operation directly on 110-volt current with a fixed resistance to absorb the difference in voltage

THE 230 tube really is a small copy of the old 20[illegible]A with the same radio characteristics, but fitted with a two-volt filament especially for use with the new air-cell battery

Electrically, these three general purpose tubes are almost exactly alike except for the filament or heater supply It is not likely that new forms of general purpose tubes will be introduced. Fewer of them are used in the latest sets than in last year's models.

The first type of screen grid tube, the old battery operated type 222, now obsolete, was developed to make the old 201A a better radio-frequency amplifier. Adding a screenlike grid element to shield the plate and bringing out the control grid connection to a cap on the top of the tube greatly reduced the internal capacity Much more radio-frequency amplification could be obtained without oscillations and the consequent squealing and distortion.

The type 224 is an electrically improved alternating current version of the old 222 The 232 is the corresponding type for two-volt battery operation and the 237 is the [illegible] continued on page 125

AMATEURS find air loaded with exciting reports in code and voice when they tune receiver to pick up vibrations that lie outside the bands in general use by regular broadcasting stations

Short Waves

Open New World of Radio

By JOHN CARR

IT TAKES neither brains, care, nor skill to tune the modern broadcast receiver. Any child can do it. Tuning a short wave radio receiver, however is quite another story. Consequently you are in for a surprise when you first try to get signals below the broadcast band

Your first sensation will be one of disappointment as you discover that tuning an amateur short wave receiver calls for great care and considerable manual dexterity Then, as you begin to learn how to tune, you will, perhaps, miss the cut-and-dried, mechanical regularity of ordinary broadcasting, for amateur short wave work does not follow definite schedules

Experimental transmissions go on the air at all hours of the day and night, police radio alarms come to you hot off the griddle while the police cars are engaged in chasing the bandits; garbled conversation from the two-way transatlantic commercial telephone service may come rolling in, long strings of code messages from the short wave international stations may challenge your curiosity, and with plenty of luck you may pick up snatches of the foreign short wave broadcasting Also you will begin to realize that there are more than 20,000 radio fans who already have licensed radio transmitters in this country alone!

You will soon discover that the dials of your amateur short wave receiver open up a whole new world of radio—a far larger and in many ways more interesting world than that of the broadcasting to which you are accustomed.

The diagram at the top of this page indicates the frequency bands that have been assigned by the United States Government through the Federal Radio Commission for amateur radio transmission. All of these bands are available to any licensed amateur for continuous wave transmission, three of them are open to any amateur for radio telephone transmission, and almost the whole width of the fourth, marked with an X in the diagram, also is open to amateur phone use under special license

Although a total of seven different bands have been assigned to amateurs, several of them are, as the figures indicate of enormously high frequency. Experimental work is going on at these frequencies, but the three bands between 14,400 kilocycles and 4,000 kilocycles are most widely used. Of these bands, the twenty-meter or 14,000-kilocycle band has proved the most reliable for use in covering great distances in daylight. The other two are fine for general distance work both day and night, with the eighty-meter band most satisfactory for domestic work.

IN CONTINUOUS wave transmission the carrier wave is broken up into dots and dashes by means of a key. You can hear it only when your own radio receiver is producing high frequency electrical oscillations. The speed of these oscillations must be such that the difference in frequency between the carrier wave and the oscillations your set generates is numerically within the range of audible sound.

Suppose, for example, your set is so adjusted that the detector tube is oscillating at 7,000,000 cycles per second (7,000 kilocycles) and the incoming wave has a frequency of 7,000,500 cycles. Your headphones will produce a sharp, 500-cycle whistling note. If you change the setting of your tickler control and thus change the rate of set oscillation, the tone of the whistling note will go up or down depending on whether the frequency difference becomes greater or less.

THE tickler control on your set governs oscillation and you can tell when the detector tube reaches the oscillation point by a slight click and a noticeable increase in the undercurrent of noise. It is common practice to tune for stations with the set in an oscillating condition when the circuit includes a coupling tube ahead of the detector

With the set in oscillation, turning the tuning control slowly will produce noises suggesting the singing of a flock of canaries. Each one of these canary-like chirps or whistles marks the location of a station. You can tell whether it is continuous wave or voice transmission by a moment's listening. If the chirp is broken up into the familiar dots and dashes of code, it is continuous wave and a further juggling of the tickler and tuning dials, done with extreme care, may make it considerably more readable. If the whistle seems to be continuous, with a broken and scratchy effect, you probably have landed a phone station. In that case you must move the tickler back with extreme care to the point where oscillation just stops. You will then get the voices if they are loud enough to hear

Assuming that you intend to go ahead with a transmitter after you get your operator's license, spend as much time as you can listening to other amateurs. Familiarize yourself with the general procedure of amateur operation.

New Controls *Add Airplane Thrill to* Safe Motoring

"Most of the new controls operate things the old cars didn't have," Gus said. "But you don't have to do anything with them unless you want to. You can set the knobs and then forget them"

By MARTIN BUNN

"I'VE decided to stick to this old bus for a while longer, Gus," Barnly announced as he stopped his car in front of the Monet Garage.

Gus Watson, half owner of the establishment, unlimbered the gasoline hose. "New cars haven't enough style for you, eh?" he smiled as he turned the crank.

"Style!" Barnly exclaimed. "I wasn't thinking of that. What I'm kicking about is the fancy complications. What's the use of making an instrument panel with as many knobs, dials, and gadgets as radio sets had in the days when tuning one of them was a skilled occupation?

"Now you take this car of mine, for instance. Just a switch for the lights and a knob for the choke, the speedometer, oil gage and ammeter and there you are, all neat and shipshape."

"It does seem funny when you put it that way," Gus agreed. "The point is, of course, that most of the new controls operate things the old cars didn't have."

"It's all wrong," maintained Barnly. "Years ago they predicted that some day everything would be automatic in an automobile. All you'd have to do would be to steer and work the throttle, with the throttle fixed so when you took your foot off it the brakes went on automatically. Millions of cars have been made since then and the more that are made the further they are from simplicity. Where's the fun in driving if you've got to keep your eye on half a dozen dials instead of the scenery and keep thinking about which knob you've got to press next instead of about what a good time you're having? Those fancy new features are a lot of bunk."

"Humph!" Gus growled. "I suppose you'd rather run out of gas than take a look now and then at a gage on the instrument board that'll tell you exactly how many gallons you have left. Or maybe you'd rather put your motor on the blink through lack of water rather than look at a motor temperature gage once in a while?"

"I don't object to the extra gages so much," said Barnly. "They're some use. But how about the knobs you have to pull?"

"WHAT car are you talking about?" Gus asked. "Some have the free wheel lock-out on the dash so you pull a knob when you don't want free wheeling. Some have an adjustment on the dash for the shock absorbers, and there may be knobs to turn on the windshield wiper, change the adjustment of the carburetor mixture, open some of the ventilators, and so on.

"At any rate," he continued, "you don't have to do anything with any of the knobs unless you want to. If you're satisfied to take an average adjustment for everything, you can set the knobs that way and forget them.

"Near as I can figure, it works out about like this: Years ago, before the self-starter was invented, automobiling was a sporting proposition. Hardly any women drove cars and the men who did had to have a good right arm to spin the motor and enough mechanical brains to fix the ordinary small troubles you ran into on the road. In those days there wasn't always a gasoline pump in sight and a service station in every town and hamlet. You had to know how to get along by yourself or wait for some other motorist to stop and help you.

"THEN came the self-starter and everybody took up driving. The majority of the new owners hadn't the faintest notion of auto mechanics, so naturally the makers tried to get everything as simple as possible. Now the years have brought a change. A new generation has grown up, and words such as 'carburetor,' 'cylinders,' 'pistons,' and 'spark plugs' don't seem like a foreign language any more. Maybe the average driver today isn't a mechanic, but at least he's got a glimmering of what it's all about.

"Another thing. You can talk all you want about an automobile being just so much transportation, but most people are thinking more about the fun they're going to get out of the car than about the time or money the car is going to save 'em. And the auto makers try their best to give the fellow that makes a hobby of his car features to help him get more fun out of it."

"Is there anything in this free wheeling, Gus?" Barnly interrupted. "My car rolls easy enough now, so what good would it do to make it roll any easier?"

"Have you driven a free-wheeling car?" Gus asked. "If you haven't, the quickest way to find out is to take a demonstration. Of course the saving in gasoline they talk about isn't very *(Continued on page 127)*

POPULAR MECHANICS WORKSHOP

Trailer Contest

Brings Out New Ideas In Touring Comfort

The Winners

FIRST PRIZE, $50

R. D. Vercier, Los Angeles, Calif

SECOND PRIZE, $25

Fred W. Knechtel, Kitchener, Ont., Canada

THIRD PRIZE, $10

A tie between Andrew Mosier, Moscow, Pa., and Robert A. Dougherty, Whiting, Ind. Each was awarded $10

FOURTH PRIZE, $5

A tie between Charles Kleinknecht, Harbor Beach, Mich., and C. H. Runes, Sullivan, Ind. Each was awarded $5

TEN PRIZES $1 EACH

H. C. Anderson, Kansas City, Mo.; Sylvester H. Brown, Mechanicville, N. Y.; C. J. Cardwell, Waukesha, Wis., Harry J. Cross, Lawton, Mich., C. E. French, Portland, Ore.; W. E. Kaiser, Jr., East Liverpool, O.; Warren W. MacNear, Ashland, Mass.; L. N. McNeal, Mt. Vernon, O.; Louis S. Reed, Chisholm, Minn., Henry E. Skelly, Bloomington, Ill.

HONORABLE MENTION

L. B. Akin, Atlanta, Ga.; W. O. Baker, Morristown, Pa.; H. Cawston, Jr., Montreal, Que., Canada; L. H. Murphy, Pontiac, Mich.; A. Maxwell, Chicago, Ill.; R. L. Randolph, Santa Monica, Calif.; B. A. Reynolds, Player, Fla.; A. M. Samp, Rockford, Ill.; R. W. Settler, Mt. Vernon, O.

(ENGINE comfort in auto camping at very low cost is within the reach of anyone who is sufficiently handy with tools to build a camp trailer. This was made clear in our recent trailer contest (P.S.M., Jan. '32, p. 106), which brought in an unexpectedly large number of excellent designs.

The prize winners are listed at the left. Their designs fell into three main classes—folding or collapsible trailers, house trailers, and tent trailers.

The first-prize design, illustrated on this and the following page, is of the collapsible type in that the top telescopes within the body and is raised by means of a crank and cables. Both of the fourth-prize designs are in the same category. One of them, illustrated at the bottom of page 75, opens out on both sides; the other (not illustrated) has one side that is lowered.

A typical trailer of the kind that is complete in itself, like a small house, is illustrated in the second-prize design at the top of page 75.

The third and less expensive type is that in which the trailer is expanded into a camp by setting up a canvas roof and walls, and this type is represented by the two third-prize-winning designs. These will be described and illustrated in an article in the June issue. One was built for $74.45, the other for about $50.

Even the folding and house type trailers are relatively inexpensive, the average for the prize winners being only a little more than $100 each. Even such an elaborate outfit as that which won first prize cost only $106.25 for materials. In his letter accompanying that design, Mr. Vercier summarized its uses and advantages as follows:

To set up camp, drop trailer legs and level. Place steps and pull rod on cupola, which releases sides. In cranking up top, the sides unfold and drop into place. Operator then releases ends, fastens buttons, puts up cupola,

and raises upper bed into place. Completed in fifteen minutes, requires same time to take down. One person can operate; nothing to pack or unpack, a place for everything, and everything in its place. When caster wheel is dropped, one person can move trailer

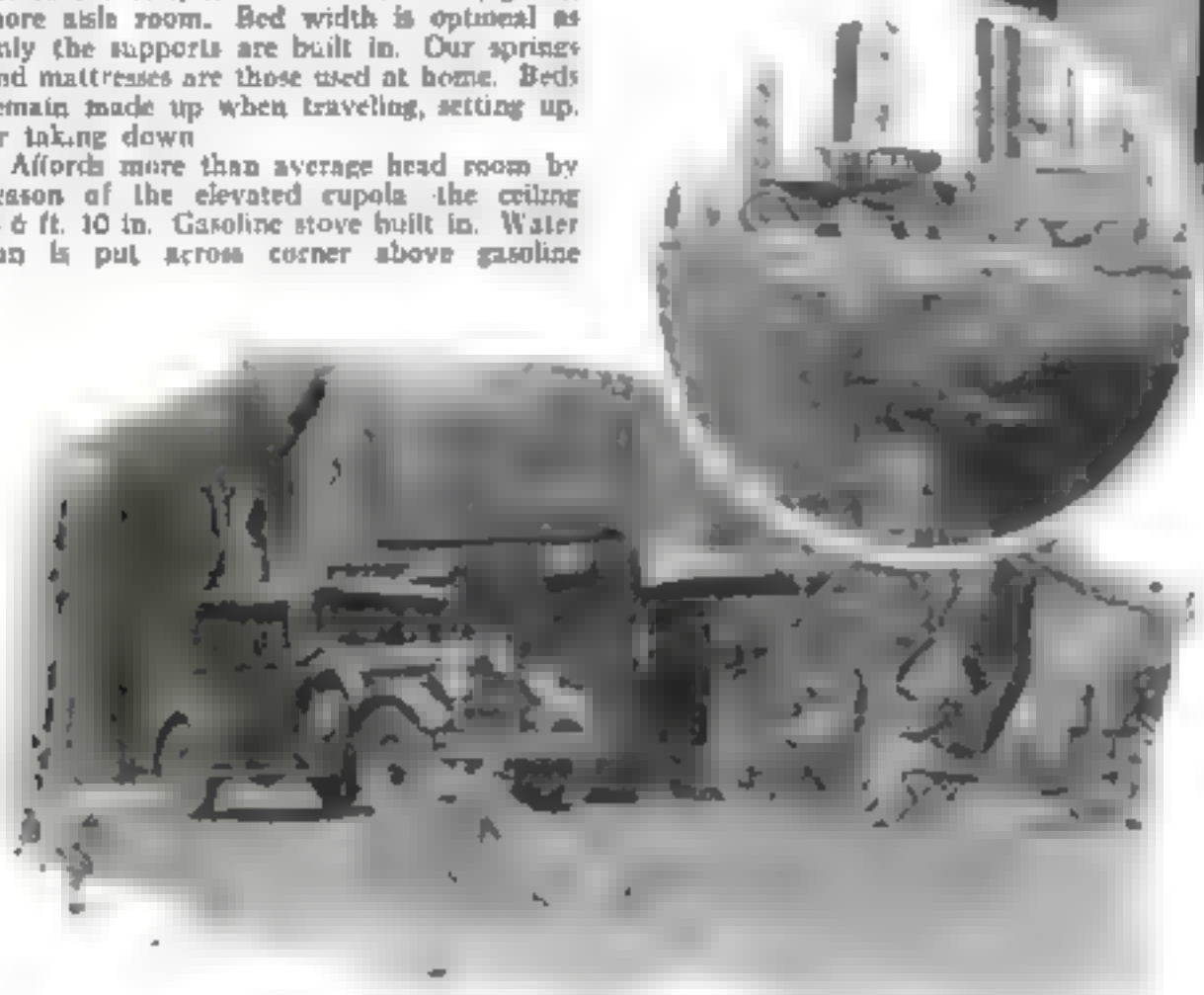
Covered with auto top material, which is superior to canvas in rain or dust. Being collapsible, it has small wind resistance in traveling, also affords low center of gravity Attains forty miles per hour without swaying. Does not extend beyond fenders.

For convenience, the beds are arranged across the end, rather than at sides, giving more aisle room. Bed width is optional as only the supports are built in. Our springs and mattresses are those used at home. Beds remain made up when traveling, setting up, or taking down

Affords more than average head room by reason of the elevated cupola the ceiling is 6 ft. 10 in. Gasoline stove built in. Water can is put across corner above gasoline

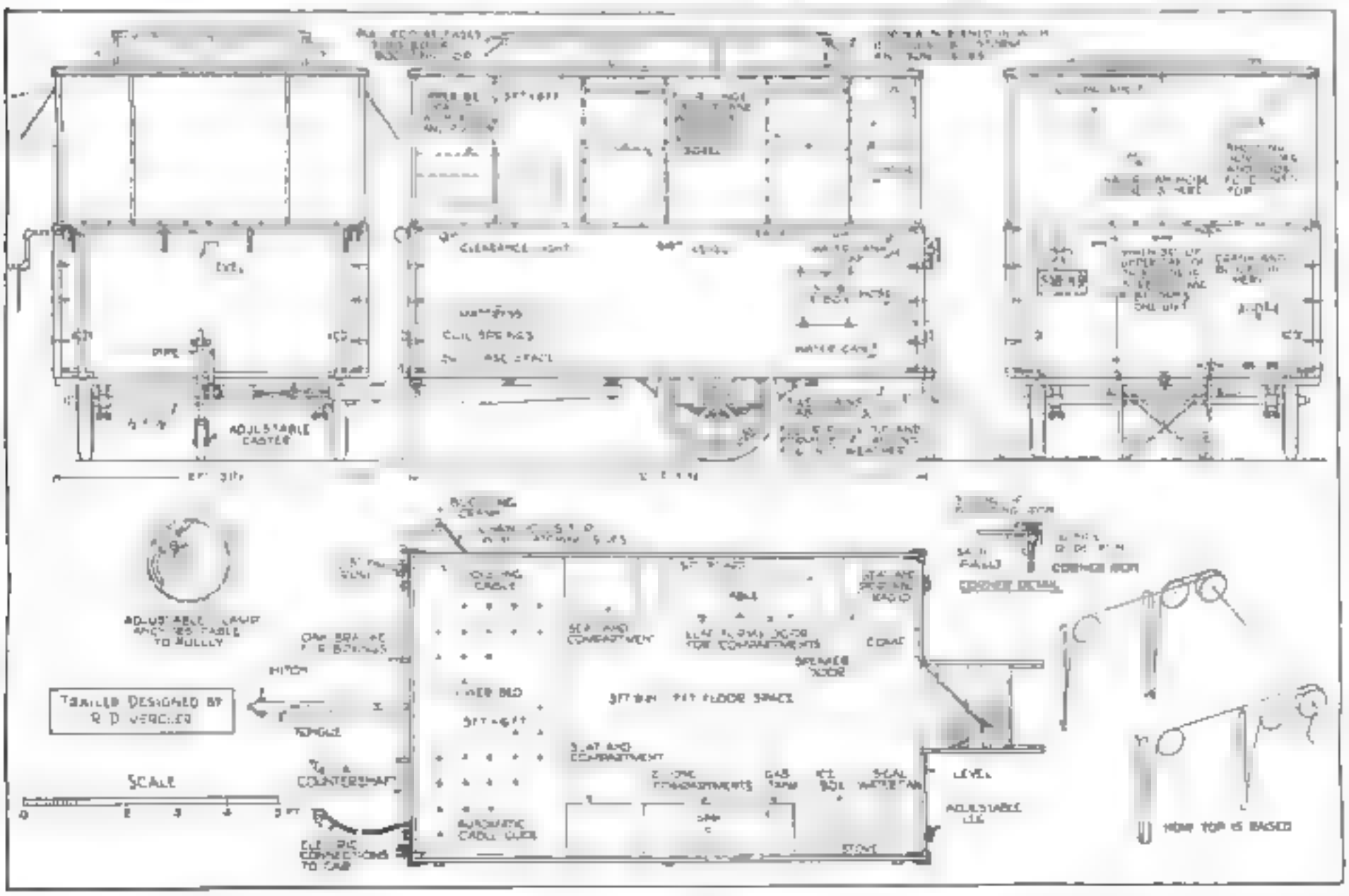
FIRST PRIZE

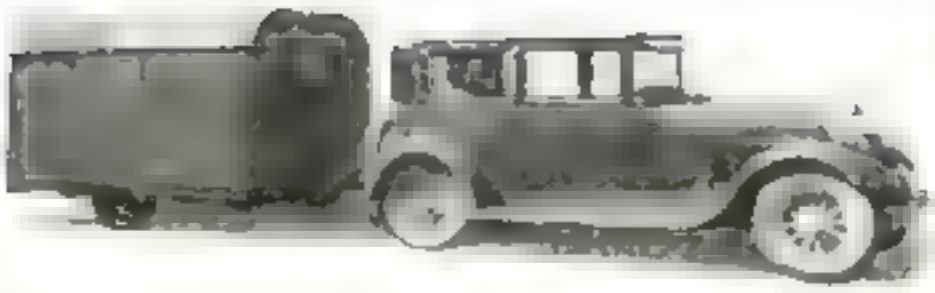
These photos and the one on the preceding page show the first-prize-winning trailer built by Mr Vercler. The construction is explained in the drawings below He has been camping for many years, and made one 11,500-mile trip

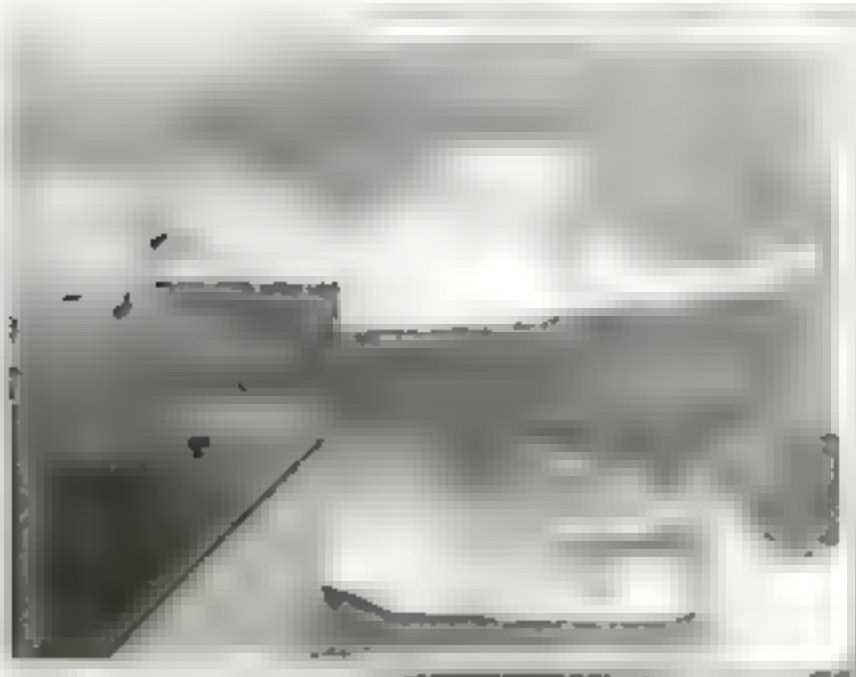


burner which warms water and is connected with hose to faucet over built in sink Waste water drains to bucket under trailer Ice box has inside and outside openings, galvanized iron drawers underneath, tray next to ice for perishables purchased *en route*. Holds fifty pounds of ice, which lasts five days. Portable radio fits into built-in seat Built-in combination drop-leaf table and sideboard seats four, using built-in seats and two canvas armchairs, and it has several folding shelves. Hinged cellophane windows, 6 ft. 4 in. from ground, shield one from the public. Privacy is afforded by use of visors. All openings are screened, and the door has a removable panel

After the trailer has been subjected to the test of its first long trip, the following changes were made: Pneumatic to solid tires; visors added to cupola; curtains on windows replaced by visors; combination "hoosting" legs replaced with wood, portable ice box replaced with built-in; utility box

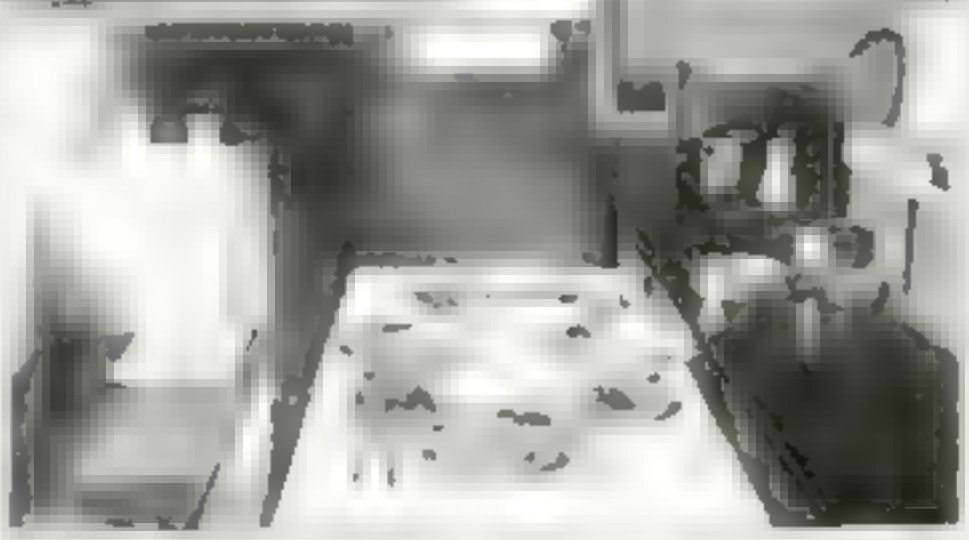






SECOND PRIZE TRAILER

Mr. Knecht of a camper is 9 ft. 10 in. long, 6 ft. wide, [illegible] ft. The upper berth folds down [illegible]



He used pressed wood composition board on the roof and walls and covered the roof with automobile top material.

The trailer of Mr. Knechtel illustrated in the lower group of photographs on this page, was designed for what he considers the four essentials—roadability, convenience while in camp, ease of making or breaking camp, and appearance on the road. His trailer is 10 ½ ft. long, 6 ft. 2 in. wide and 6 ft. 11 in. from pavement to top of roof, weight 1,210 lb.; cost exclusive of labor and tires, $110. He used the front axle and wheels from a discarded model A Ford. The frame consists of 3 by 5 in. ash stringers and 2 by 2 in. side pieces; ceiling, 1 in. oak rafters covered with ¼ by 3 in. pine strips. The body is covered with pressed wood composition board. The roof is waterproofed and painted canvas over balsam wool

placed under floor at back; flat cable drums substituted for V-type, and an eyebolt in tongue substituted for stay rings.

Itemized cost. Axle, wheels, springs (second-hand), $5; tires, $12; tongue, $2.50, oak, 80 lineal ft. 2 by 3 in., $5, flooring, 80 ft., $3.20; siding, 96 ft. ¾-in. three-ply, $9.60; corner irons (old bed rails), $1, welding brackets, $2.50, paint and shellac, $7, insulating board, $2; galvanized iron, $1.50, gasoline range top (second-hand), $2.50, water can, $.85; sink pan, $.15, countershaft, $1.50, cable drums, $1; casters, $1.50, cable, $.90, strap iron, $.50, levels, $.40, hardware and screening, $8.90, upper framework, $5.50, auto top material, $12.50, celluphane, $1.50; electric system, $6; three-ply cabinet lumber, $4; sink fixtures, $1.25, aerial, $1, miscellaneous, $5. Total, $106.25

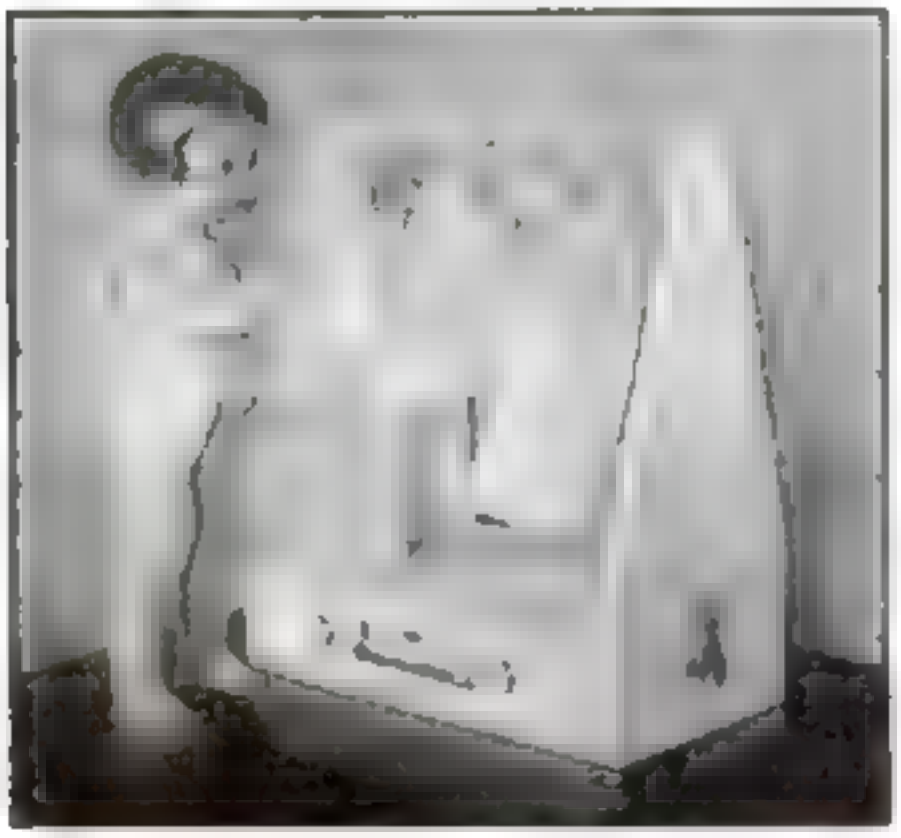
Mr. Knechtel, who won second prize, prefers a complete house trailer because he believes it to be more durable, more dust-proof, insect-proof, and storm-proof, and more convenient than the folding type. He likes to be able to leave for a picnic on a moment's notice and to have a bathhouse along when he goes bathing. In his notes he said:

Home constructors have their own pet notions and often wish to use materials which they have on hand, but there is a little advice I feel should be given. The trailer should be built low. The axle in my trailer is machined from 1½ in. square steel to drop 4 in. below the center of the wheel spindles. The springs should be spaced apart no less than 39 in.

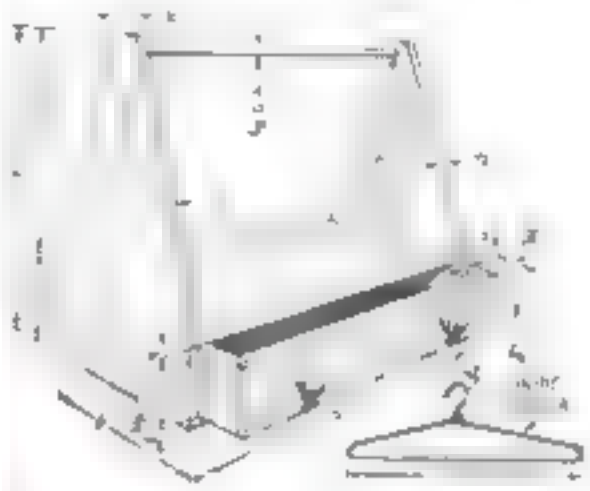
A FOURTH PRIZE DESIGN

[illegible] of full size but hinged in the center. [illegible] by 48 [illegible] that folds into a desk only 15½ by 28 in.

THIS WARDROBE KEEPS DOLLY'S CLOTHES IN ORDER



The completed wardrobe and, below, a drawing to show the method of construction and suitable dimensions. The author used soft wood and finished it with two coats of ivory paint and two of quick drying enamel



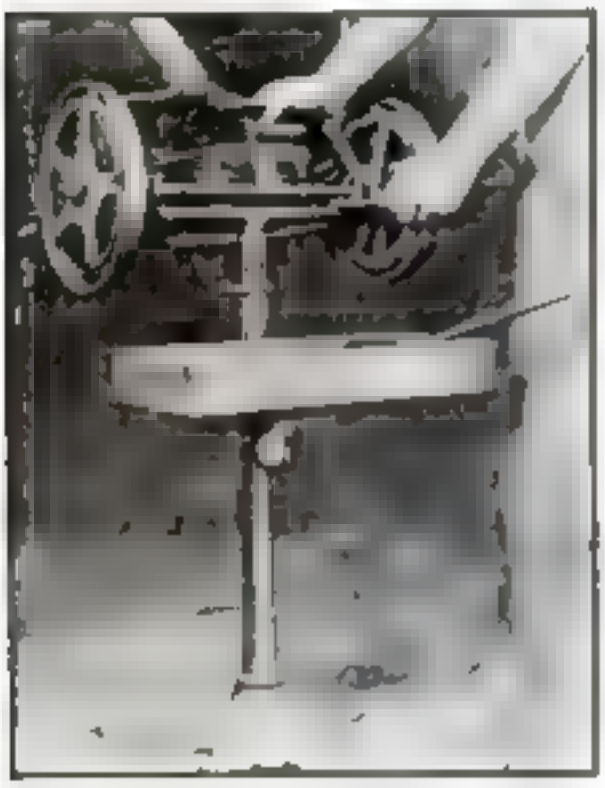
In every home where there are young girls, the problem of keeping doll clothes in order may be solved by constructing a little wardrobe like the one illustrated. The general layout and the over-all dimensions are given in the drawing, but because of the simplicity of design the minor details may be worked out to suit the maker and the material at hand.

The dowel rod at the top may either be bought, turned on the lathe, or made with plane and sandpaper. It is glued into holes bored halfway through the ends. The drawer is of ⅜-in. material except the front, which is ¾ in. thick. A ⅜-in. board fitted into the back of the drawer opening gives a more finished appearance and serves as a drawer stop. Small knobs for the drawer may be turned or bought. If made, a short dowel should be turned on each knob, to be glued in a corresponding hole drilled in the drawer front.

The proper finish for the wardrobe will depend on the material from which it is made, as well as the taste of the maker. If a good cabinet wood is used, it should be stained, filled, and finished to bring out the beauty of the wood. If made from soft wood, it may very well be painted and enameled. The one shown in the photograph was given two coats of ivory paint and two coats of quick drying ivory enamel. The decalcomania transfers add a festive touch and give a more finished appearance.

The hangers may be sawed out of thin wood with screw hooks inserted at the top, or they may be bent from stiff wire. If wire is used, the material can be readily obtained by cutting up some of the common wire hangers that clutter up most clothes closets. When cut off close to the hook and straightened out, the resulting piece of wire will make two of the little hangers. They may be easily bent to shape with a pair of pliers, the size shown in the drawing being about right. Copper wire can be used for the hangers, if preferred.—Lee M. Klinefelter.

STAND FOR REPAIRING LAWN MOWERS

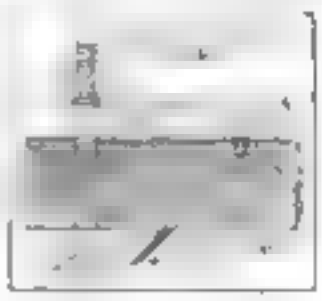


A stand of this type saves time in a small shop where lawn mowers are often repaired

Lawn mower repairs can be made more easily with the aid of a stand like that illustrated. The bottom section is 18 in. high, of hollow tubing or pipe, with either forked legs or a flat metal base. It may be assembled by welding, or something suitable may be found in the junk pile. Near the top of the hollow stem, a small nut is welded over a hole. A thumb screw passing through this nut and hole regulates the height of the upper section of tubing, which is 18 in. long and a sliding fit inside the bottom one to allow easy adjustment.

To the top of the second tube is brazed or bolted a section of light strap steel about 16 in. long, with a short fork cut in each end and turned to point upward. The axle of the mower fits into these forks, while the roller rests on a curved 14-in. section of ¾-in. bar, one end of which fits about the upper tube. Pressure on the outer end of this bar acts to hold it from slipping down on the tube. A 6 by 18 in. wooden box, 2 in. deep, is attached to the stem of the stand by a Y-shaped strap underneath, the lower end of which clasps the tubing and is fastened with a set screw. As the mower is dismantled, the small parts, which are often mislaid while the repairs are being made, are dropped into this box.—Joseph C. Coyle.

BOLT SET IN BENCH TOP FOR CLAMPING WORK

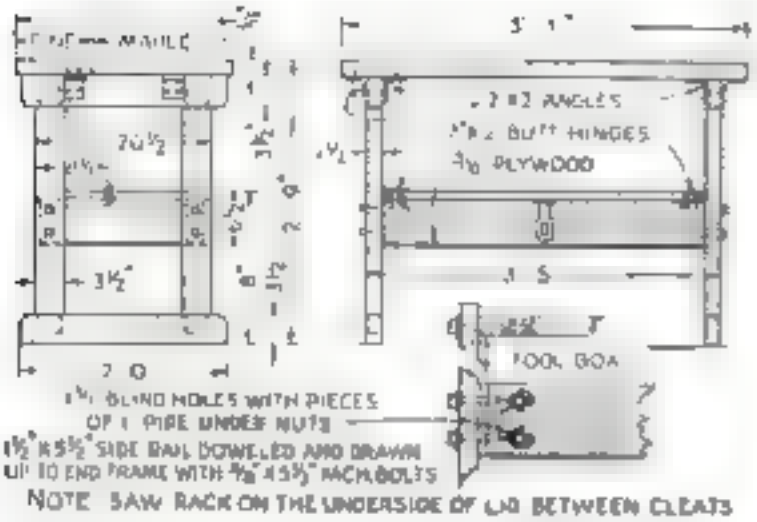


Under the front edge of many workbenches is an apron that prevents clamping anything to the top. To overcome this I put a bolt, thread end up, through my bench top about 3 in. from the front edge. When not in use, the bolt is pressed down flush with the top and held in that position by a clip formed as indicated. The clip is swung to one side when it is desired to drive up the bolt for use.—W. P. Stephens.

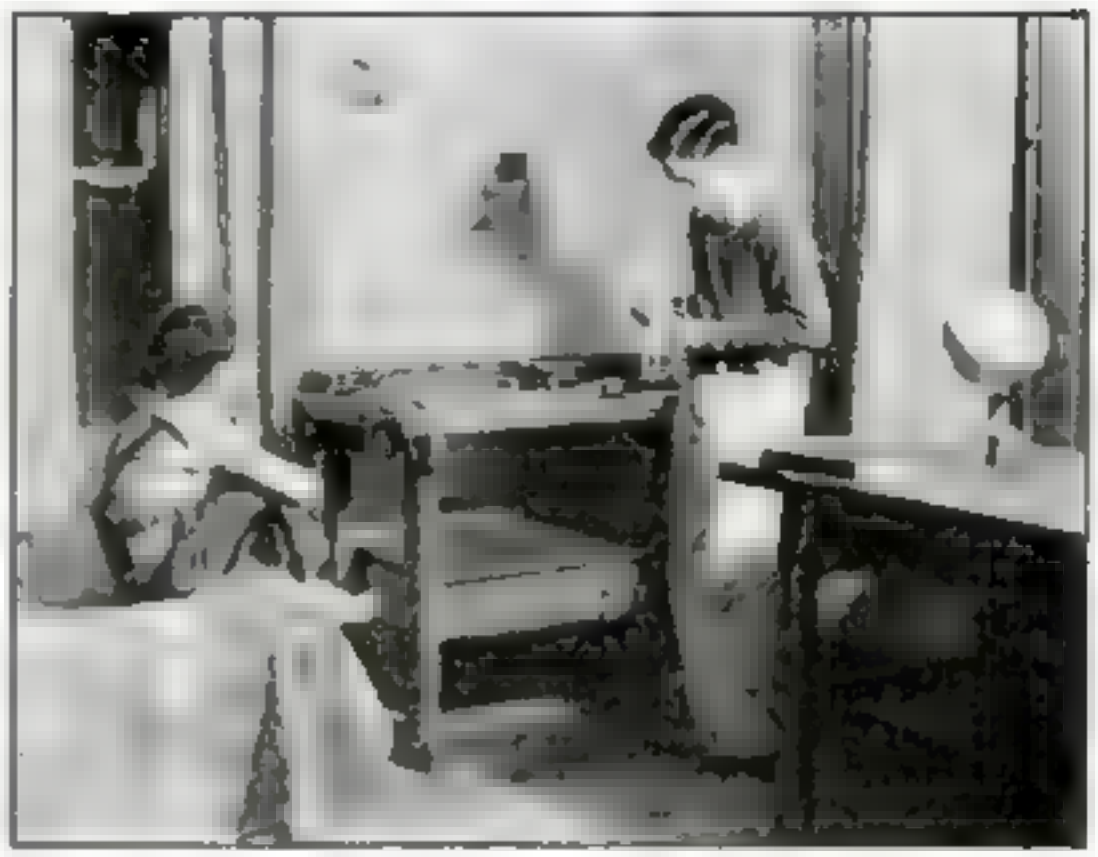
METAL DOWELS REPAIR BROKEN CHAIR LEGS

This use of a length of small gas pipe or a steel rod in repairing a broken chair leg results in a much stronger joint than where a wooden dowel is employed. In the case of a bad fracture, a wood composition of the type that is sold in tubes should be used to fill in chunks and spaces where the original wood has broken out. The old broken wood dowel, if there was one, is bored out with an auger bit; then the pipe or steel rod is well coated with the thin wood composition and inserted in the hole. The accompanying photograph shows the position of the pipe in repairing a particularly bad fracture just before the leg was moved up to its normal position against the bottom rail of the chair.—Charles B. Barr.

NEAT WORKBENCH AND TOOL CHEST FOR BOY'S ROOM



NOTE SAW RACK ON THE UNDERSIDE OF LID BETWEEN CLEATS



Although this sturdy combination workbench and tool box was designed for use in a boy's room, it might well serve as a model making table for the grown-up who hasn't much room for a shop

Any boy who has the least mechanical streak in him is encouraged to build models and make experiments when he has a suitable combination workbench and tool chest set up in his own room. A hobby such as model making need not be restricted to the cellar or garage if parents are willing to forego some-thing of formal order and alter it this is a small price to pay for the right kind of employment at home. With tools neatly stored in the locked compartment below—and, strange to say, they are often so stored—the bench illustrated which is painted an olive drab color and has a shellacked maple top, is by no means an unsightly piece of furniture. As proof that pride of possession leads to careful habits, the boy who owns the bench illustrated keeps the few high-grade tools he uses in perfect condition and never allows them to become scattered.—D O N

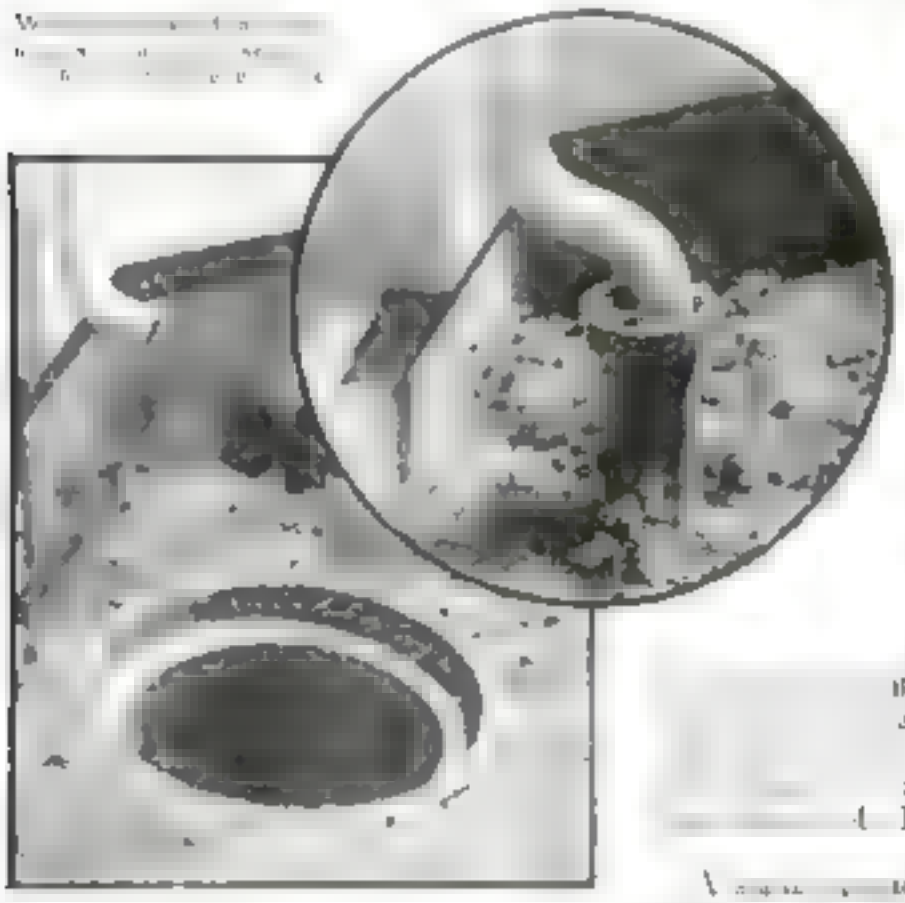
GETTING RID OF RAIN PIPE WATER

Unsightly and makeshift devices for the disposal of the drainage from roof gutters may be eliminated by an installation like that illustrated, provided the soil is reasonably loose and gravelly and not hard clay.

A standard drainage tile about 24 in. in diameter is obtained, and a hole is dug for it in such a position that the rain pipe can conveniently empty into it. When placed vertically with the large end upper most the tile should be about 6 in. below the surface of the ground. The earth is then packed solidly around the outside and wet down at intervals during the process so that there will be no settling after the job is completed

The top end of the tile is now covered with any old (thin) lumber, wall board, sheet metal, or other scrap material. This is cut so as to rest on the shoulder of the large tile. In case the material is too thin to withstand the weight of the concrete to be placed upon it, it should be supported in the center by a stick. Before placing the cover finally in position, a hole should be cut in it large enough to pass a 2 ft. long section of tile about 6 in. in diameter which is to receive the end of the rain pipe (see photograph at left). The cover is then set in place, and the small end of the 6-in. tile is passed through the hole far enough so that the top will be the proper distance above the ground as determined by the height of the end of the rain pipe. It is then held in place by small wooden wedges

The next step is to fill the space on top of the cover with concrete up to the top of the large tile. After this has set it may be covered with sod and planted with [illegible] may be turned into part as shown in the illustra-tion.—D Y [illegible]


A standard 24-in. tile, set slightly below the ground level, forms the drainage basin

A tobacco sack filled with sand makes an excellent fishing line sinker in an emergency.—C. B. Deas

BOTTLE HELD ON SHELF WITH SUCTION CUP

Bottles can be kept from falling off narrow, unprotected shelves by nailing small rubber vacuum cups to the wall behind them. Arrange each cup so that it is near the top of the bottle it is to hold. The cup will hold better if it is moistened slightly. In removing the bottle, either give it a sharp pull or pry the suction cup loose with the tip of the thumb nail.—R T N

GARDEN HOSE WASHER

A temporary substitute for a garden hose coupling washer may be made from the cork insert in an ordinary bottle cap. With a sharp knife or scissors, cut a hole in the center of the cork the same size as the inside diameter of the hose, and trim the outside to a snug fit in the hose coupling.—Roger L. Bridgeman

FOR GOOD PHOTOS

You Need a Good LENS

By Frederick D. Ryder, Jr.

THE VITAL part of a camera is the lens. It produces the actual image that is recorded on the sensitive film, and the rest of the camera assists the lens to do a good job.

The lens refracts or bends the light rays that reach it from the objects being photographed to form a tiny reproduction of the original scene.

Suppose you are taking a picture of a house. A brass door knob, because of the distance, appears as a point of light in the center of the finder. Light is being reflected from this brass door knob in every direction. Rays from it strike every portion of the exposed surface of the lens. The rays that strike the lens form a cone with its apex at the door knob and its base on the surface of the lens. Those light rays in this cone that strike the center of the lens pass straight through, because light rays are refracted or bent only when they pass from one medium to another at an angle. The center rays make a spot of light on the sensitive film. The rest of the rays in the cone will be bent toward the center rays because of the angle at which they strike the glass surface at the front of the lens and the angle at which they leave its rear surface. If the lens is properly focused, these light rays will come together at the same point on the surface of the film as shown in Fig. 3. They will form a short cone of light inside the camera with its apex the point on the film and its base the rear surface of the lens.

The light from every other point on the house will go through the lens in the same double cone formation. Their combined effect is a complete miniature of the scene in front of the lens.

The distance from the lens to the object must have a definite relation to the distance from the lens to the sensitive film if the outer and inner cones of light are to have their apexes at the door knob and the surface of the film. Move farther away from the object, or move the lens nearer or farther from the film

Fig. 2. The same scene taken with a reading glass. Note the increasing curvature toward the edges

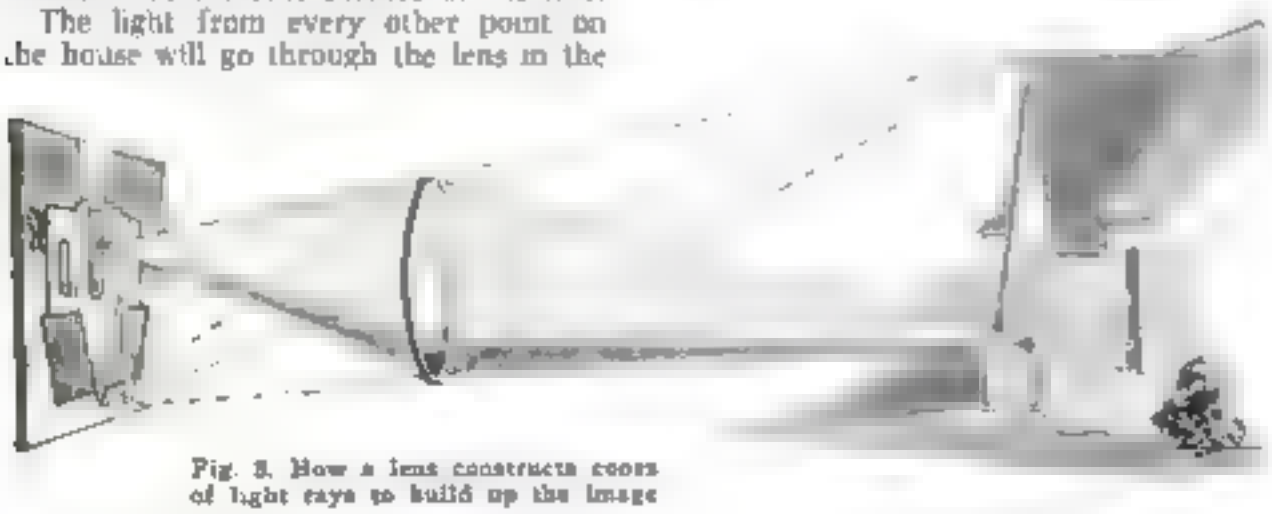


Fig. 3. How a lens constructs cones of light rays to build up the image

Fig. 1. Compare this photograph with [illegible]

[illegible] image on the lens the rays are [illegible] objects will [illegible] one of the cones [illegible]

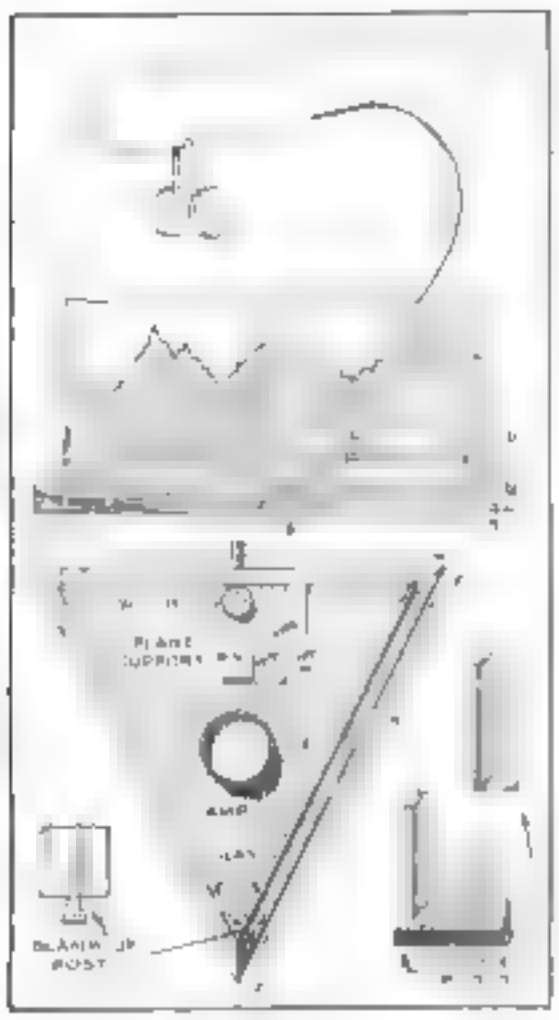
ture being rendered so fuzzy as to be [illegible]

The picture in Fig. 2 was taken with an ordinary reading glass. The result could have been improved to a considerable degree by using a very small stop or opening in front of the lens. This would have cut off the rays coming through the outer portion of the lens. It is in these rays that the distortion occurs.

A perfect lens should produce no distortion. Straight lines in the objects being photographed should be reproduced as straight lines on the film. All points in the plane for which the focus is set should appear with needle-like sharpness. That means if you photograph the side of a shingled house, for example, and your camera is pointed squarely, the lines marking the shingles should be needle-sharp clear out to the edge of the picture. The ability of a lens to give sharp definition to the edge of the picture is commonly spoken of as "covering power," and the quality and expensiveness of a lens are determined by how large a stop or opening through the lens can be used and still obtain this critical definition.

The large opening is desirable because it determines (Continued on page 112)

EASILY MADE AIRPLANE SHADOW LAMP



At left A side view of the base with the position of the model indicated, and a top view with details of glass holders. *Above* The finished ornament

An unusual and attractive airplane shadow lamp may be made simply by mounting a small model over a triangular base of the type shown in the accompanying illustrations. In this case the model is a Vought "Corsair" constructed from plans given in a previously published article (P.S.M., Mar '31, p. 117)

The base is of ⅞ by 7 by 7 in. hardwood, cut to a triangle and with the upper edges beveled. A hole is bored to hold a chainless, keyless socket from which the cap portion has been removed. Two small holes are drilled clear through the base for the wires, and channels are cut for them in the underside of the wood. A piece of thin rubber or other insulating material should be placed in the bottom of the large hole before the socket is finally placed in position. A small switch of the type frequently used in electric wall fixtures is set in the center of the rear edge of the base from the underside and held securely by the nut which accompanies it. To make a neat job of the connections, this switch can be opened and one of the wires removed from the spring clip to which it is soldered. One wire from the electric light plug is then soldered to the spring clip, and the clip replaced. This extra work, however, is not essential

Light metal which is easily bent but without spring is used to hold the plane above the base in a forward tilting position. The lower rim of the wheels should clear the glass by about an inch. The ground or frosted glass used for the sides should be of sufficient height to hide the bulb, which likewise should be frosted and as small as can be obtained. For the base shown two pieces of glass from 2½ to 3 in. high by 6½ in. long are required. The holders are made from rectangular pieces of tin or other thin metal, bent double. The front holder may be fastened with a small screw or brad, the rear holders with screws

The star and circle insignia on the upper wing and the bars on the rudder are painted red, white, and blue. The remainder of the model, as well as the base and the glass holders, may be stained to match the radio cabinet or other piece of furniture upon which it is to be placed. The ground side of the glass, which should face inward, should be painted with any suitable design such as mountains or a city skyline.—George C Denny

SMALL ELECTRIC HEATER FOR WORKBENCH USES

In certain types of craft work, many delicate parts have to be warmed slightly for gluing or decorated surfaces have to be dried with a gentle heat so that there will be no delay with following operations. A convenient device for applying heat in such cases consists of a cigar-lighter unit, a flasher plug, and an ordinary lamp socket with a cord of suitable length. The flasher is inserted to keep the lighter from becoming too hot. Both lighter and flasher can be obtained for ten cents each in many well-stocked five-and-ten-cent stores, and a search in the junk box will reveal an old socket and a piece of lamp cord long enough to reach any part of the bench top.—F. W

Cigar lighter used as small electric heater for drying and warming delicate craft work

A SPEEDY WAY TO PAINT INSIGNIA FOR CLUBS

Through the use of a stencil, it is possible to reproduce a given design time after time, but the result often fails to have the finished appearance of a real job of striping, lettering, or decorating. If, however, the stencil sheet is held in place and the outline carefully scratched on the surface to be decorated, the design may then be filled in with brush and colors with every expectation of a highly finished, hand painted appearance, because the scratches, small as they are, hold the colors within their bounds and prevent all runs and ragged edges. By using a quick drying paint, it is possible to transfer and paint two designs, then finish off the first with narrow black lines, next scratch and paint the third and finish off the second, and in this way keep up a continuous progression. The narrow black lines cover up all small defects. This plan saved the writer much time in decorating twenty canoes.—Jack Hazzard.

USING ONE NAIL TO SET THE HEAD OF ANOTHER

When no nail set is at hand, the head of a finishing nail or, for that matter, any kind of nail, can be driven into the surface of the work by holding the head of another nail on it as shown and striking the uppermost nail with a hammer. Composition wood then can be applied to fill the hole and conceal the sunken head of the nail.—R. W

CABINETS *for*

made from oil cans and

By EDWARD THATCHER

Fig. 1. Four types of cabinet drawers are shown in the oval above. The first is a square 1-gal. oil can; the second a cigarette box; the third all tin; the fourth, tin and wood

CONVENIENT and neat looking cabinets for storing small tools, hardware, and supplies in the home workshop may be constructed from old oil cans, tin cigarette boxes, and other inexpensive materials.

Perhaps the simplest cabinet drawers of all are made from the square 1-gal. cans used for lubricating oil. These fill the central and largest drawer case in Fig. 7, and one of the drawers is shown at the top of Fig. 1.

After draining out as much of the oil as possible, place the can in the position shown at *A*, Fig. 5, and scribe a line along the sides and bottom about 4½ in. up from the surface on which the can is resting. Use a surface gage for this if you have one. Puncture the can at point *X* with a can opener and cut from right to left across to the line on the other side as shown in Fig. 2. Do the same at the other end of the can. Then use tin snips to cut along line *Y* as shown at *A* in Fig. 5 and also in Fig. 2. Bend up the two cut parts as at *B*, Fig. 5. Scribe another line *Z* about ½ in. above the first line marked, and cut off the tin above this line. Hold the open part of the can toward you as you do this.

As you cut each can, turn it over a pan and let the residue of oil drain out; save this for future use. Now bend down the cut edges by the method shown at *C*, Fig. 5. Continue folding over this edge by placing the side of the can over a projecting board end as suggested at *D*. Do not hammer the tin tightly together, but leave a rounded edge at the top as at *E*. Then fold down the back edge of the drawer.

Use a blowtorch to soften the solder that holds the pouring spout or filler in place, and knock this part right off. Hammer down the slight projection left, and solder a label holder over this hole.

The label holder may be made as shown at *F*, Fig. 5, from a part of the tin already cut off. First cut a piece of tin slightly wider than the label card to be used, double it, and hammer it flat. Place this inside the blank for the label holder and fold the edges over it. The smaller label holders shown at *G* are made in the same way but from thinner tin, such as a tomato can.

The oil can handles are very strongly soldered, but you may reënforce them with rivets, if you think it desirable. Before painting the drawers, wash off all dirt and oil with gasoline applied with a stiff brush or by means of a spray gun. All the containers illustrated were painted [illegible] aluminum handles and label

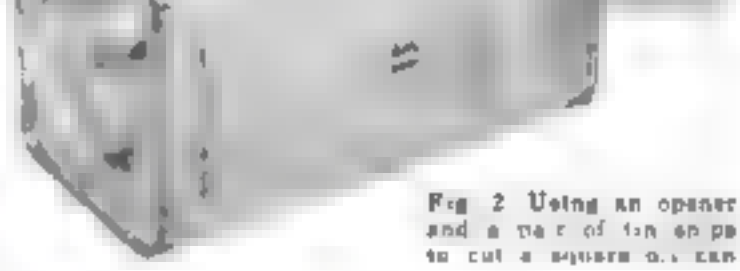


Fig. 2. Using an opener and a pair of tin snips to cut a square 1-gal. can

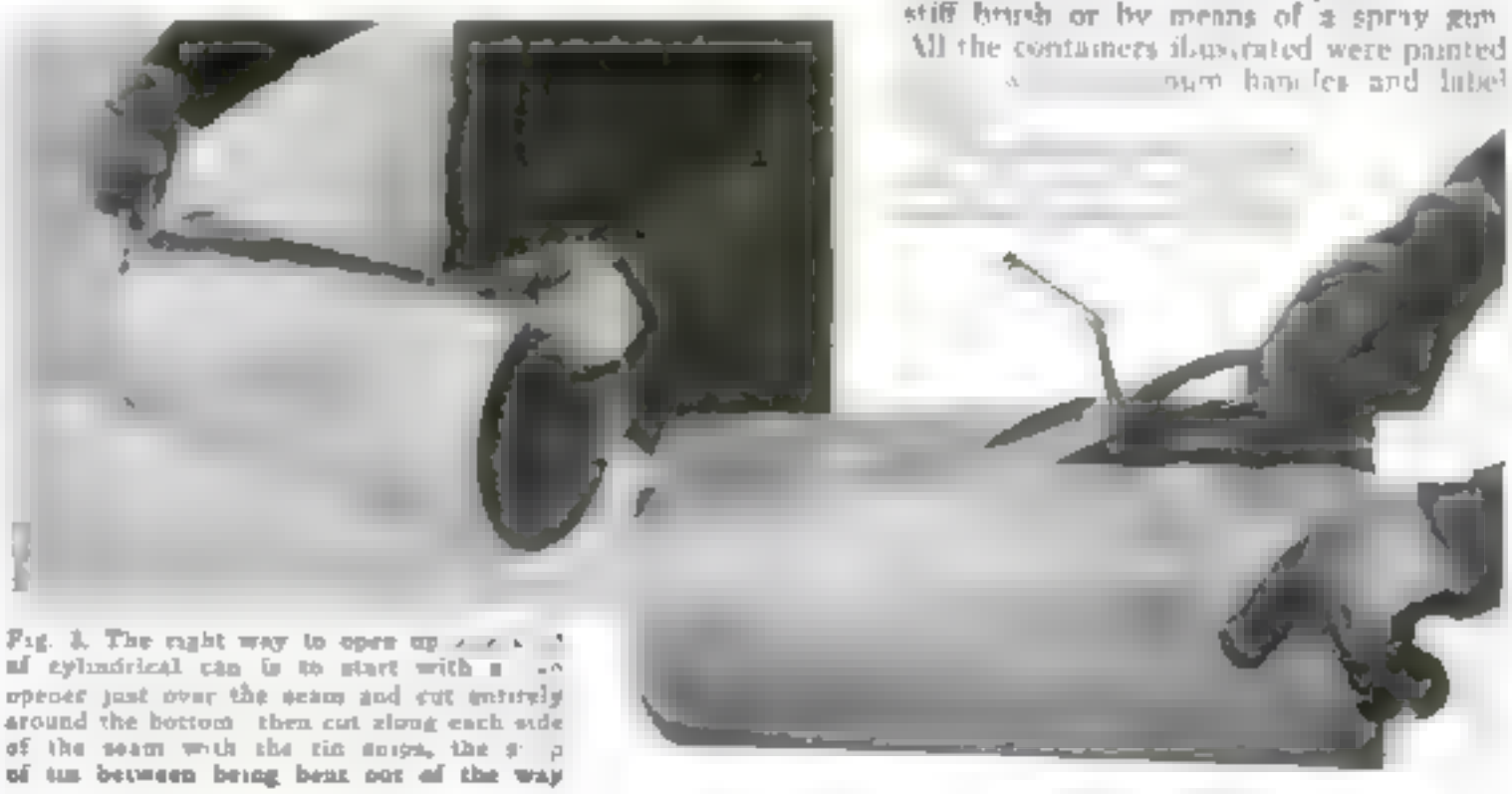


Fig. 3. The right way to open up a [illegible] of cylindrical can is to start with a can opener just over the seam and cut entirely around the bottom; then cut along each side of the seam with the tin snips, the strip of tin between being bent out of the way

Home Workshop Use

other scrap materials

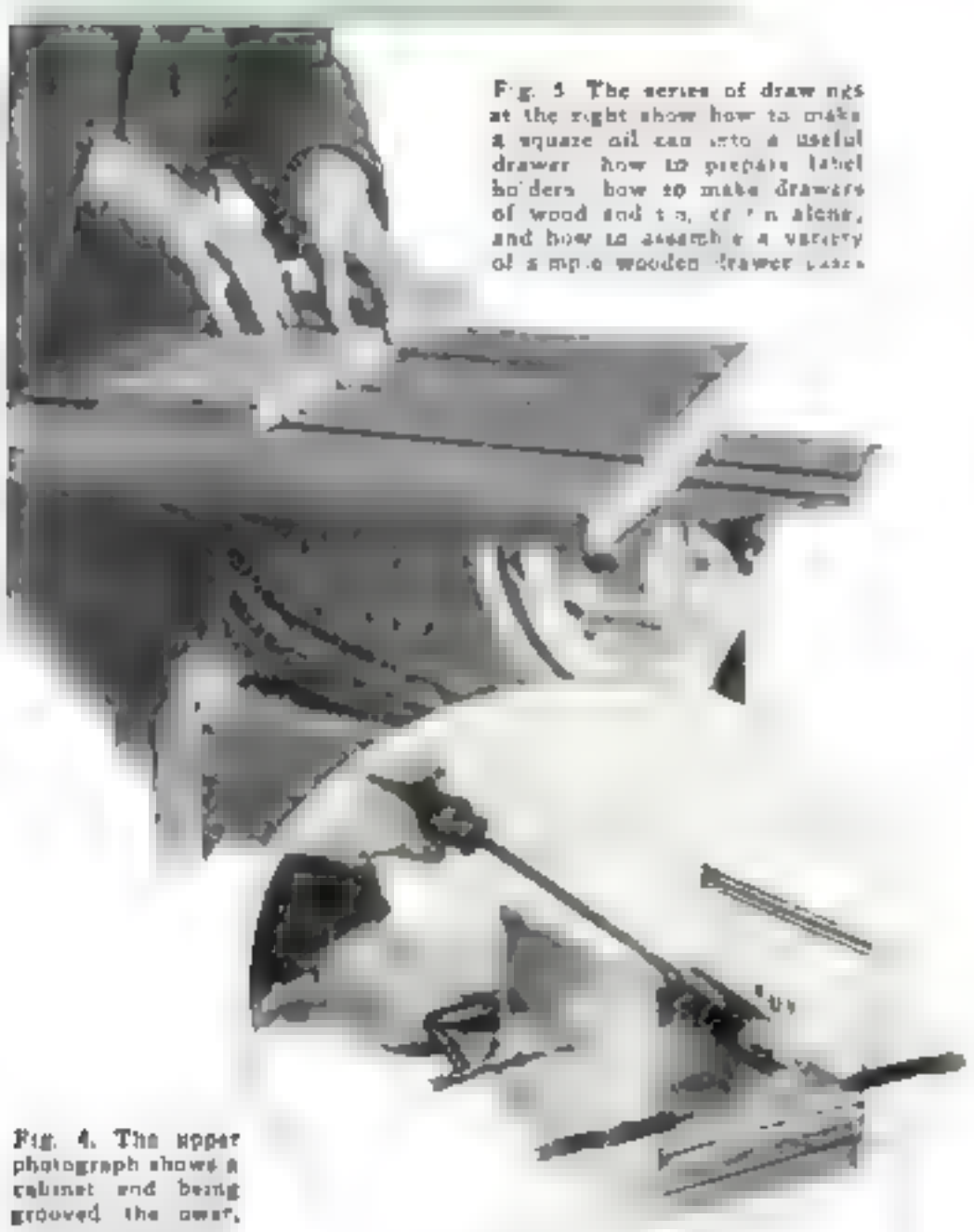


Fig. 3. The series of drawings at the right show how to make a square oil can into a useful drawer, how to prepare label holders, how to make drawers of wood and tin, or tin alone, and how to assemble a variety of simple wooden drawer cases

Fig. 4. The upper photograph shows a cabinet and being grooved the owner, an easy way to solder up a small case from cigarette tins

tom of Fig. 1. The back and front are wood, the sides and bottom are tin. For making these, the writer cut the tin from cans used for shipping ice cream in dry ice. These he found he could purchase for very little, since the ice cream dealer did not ship them back to the manufacturer.

The right way to open up these or any kind of cylindrical can is shown in Fig. 3.

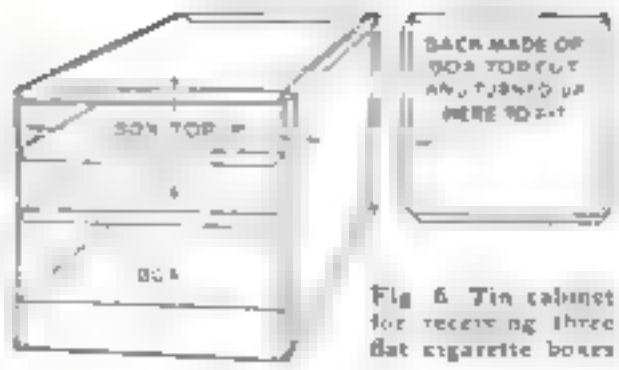


Fig. 6. Tin cabinet for receiving three flat cigarette boxes

The cut is started with a can opener just over the seam and continued from right to left completely around the bottom of the can. Next a cut is made along each side of the seam with the tin snips, the cut portion being bent out of the way as the cut proceeds. Then you may flatten out the can and cut off the rolled edge at the top.

The tin for each drawer is cut as shown at *H*, Fig. 5. A sewing thread spool sawed in half is fastened to the front of the drawer with a flathead stove bolt to form a handle. The label holders are made as previously described. In this particular instance, the drawers were made to fit in a strong lock corner packing box that once contained ginger ale bottles, and the partitions were cut from the ends and center divisions of orange crates.

Another type of all metal drawer may be made as shown at *J*, Fig. 5. One of these drawers is illus- *(Continued on page 111)*

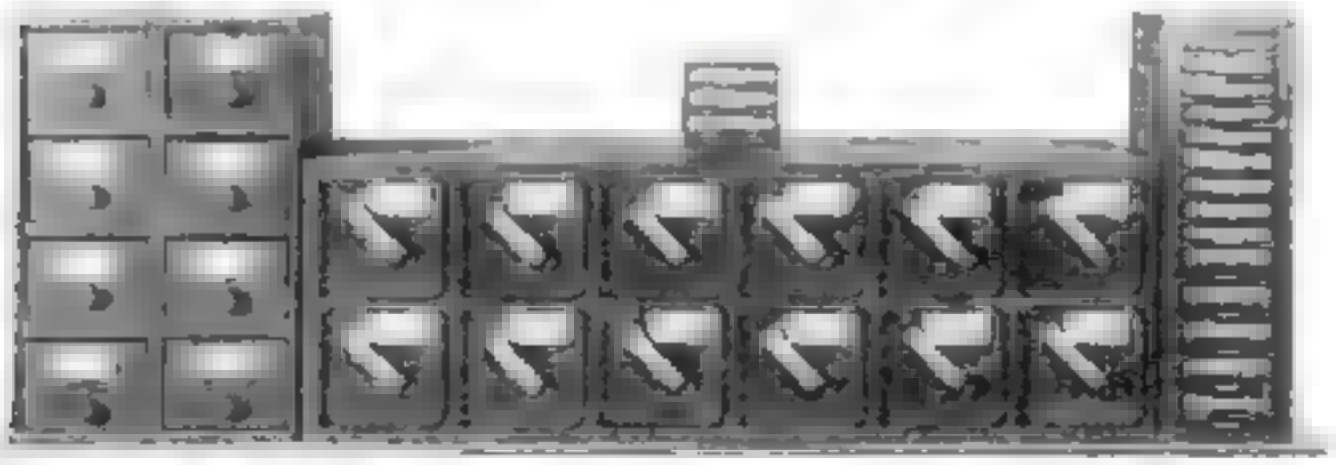


Fig. 7. Set of cabinets made by Mr. Thatcher. The large central one is filled with oil cans that on the left with drawers made of tin and wood, the others with flat tin cigarette boxes

DESERT SCENE PICTURED IN A FLOWERPOT

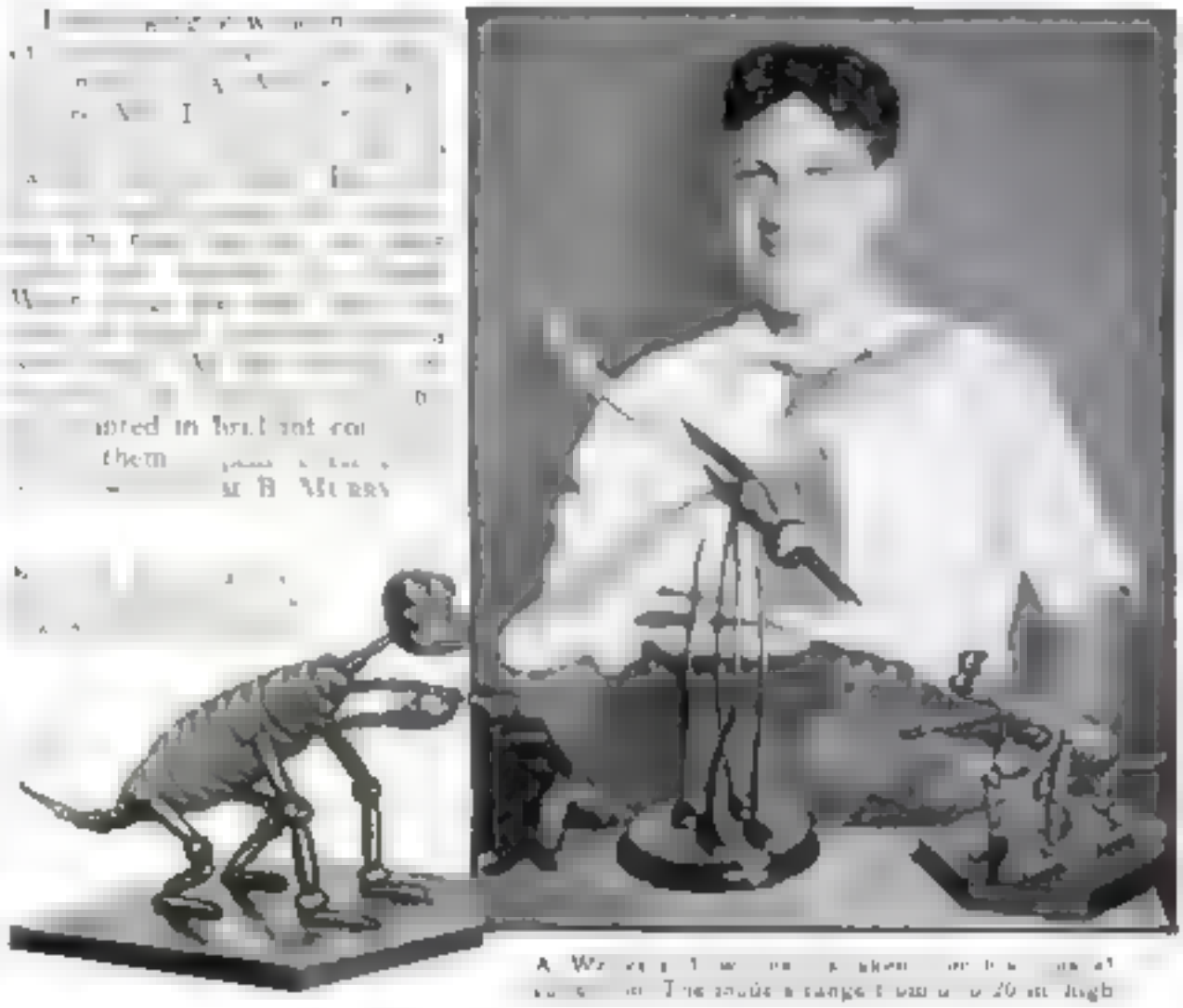
CACTUS plants, which are now so popular for decorative purposes and can be bought at almost any flower shop or even in some ten-cent stores, can be grouped in a flowerpot or dish to represent a desert scene in the same way that minature Japanese gardens are made. If a flowerpot is used, place a bit of broken pottery or a stone to cover the hole in the bottom. Fill the pot with small pebbles for about 1½ in.; these are necessary because cacti will rot if the roots are too moist. On the pebbles place a mixture of equal parts of good soil and silver sand, to which a trace of lime has been added.

Plant the tall cacti in the back and the smaller ones in front. Use stones to represent small and large rocks, and cover all the remaining space on top with silver sand to a depth of ½ in. Sprinkle a few pebbles on the sand. Then prepare a sign from balsa wood or a piece of a berry box and paint or draw on it with pencil a skull and crossbones and add the legend, "POISON WATER—GOOD WATER 2 MILES." Two snakes, one sunning itself on a rock and the other coiled as if to strike, may be made from 3-in. lengths of No. 18 bell wire. Flatten one end with a hammer, add a lump of solder, and file it to the shape of a snake's head. File the other end to a long taper to represent the tail. Dip the snakes in black enamel and paint eyes and spots on them. A skull may be made from a wood composition or plaster of Paris.

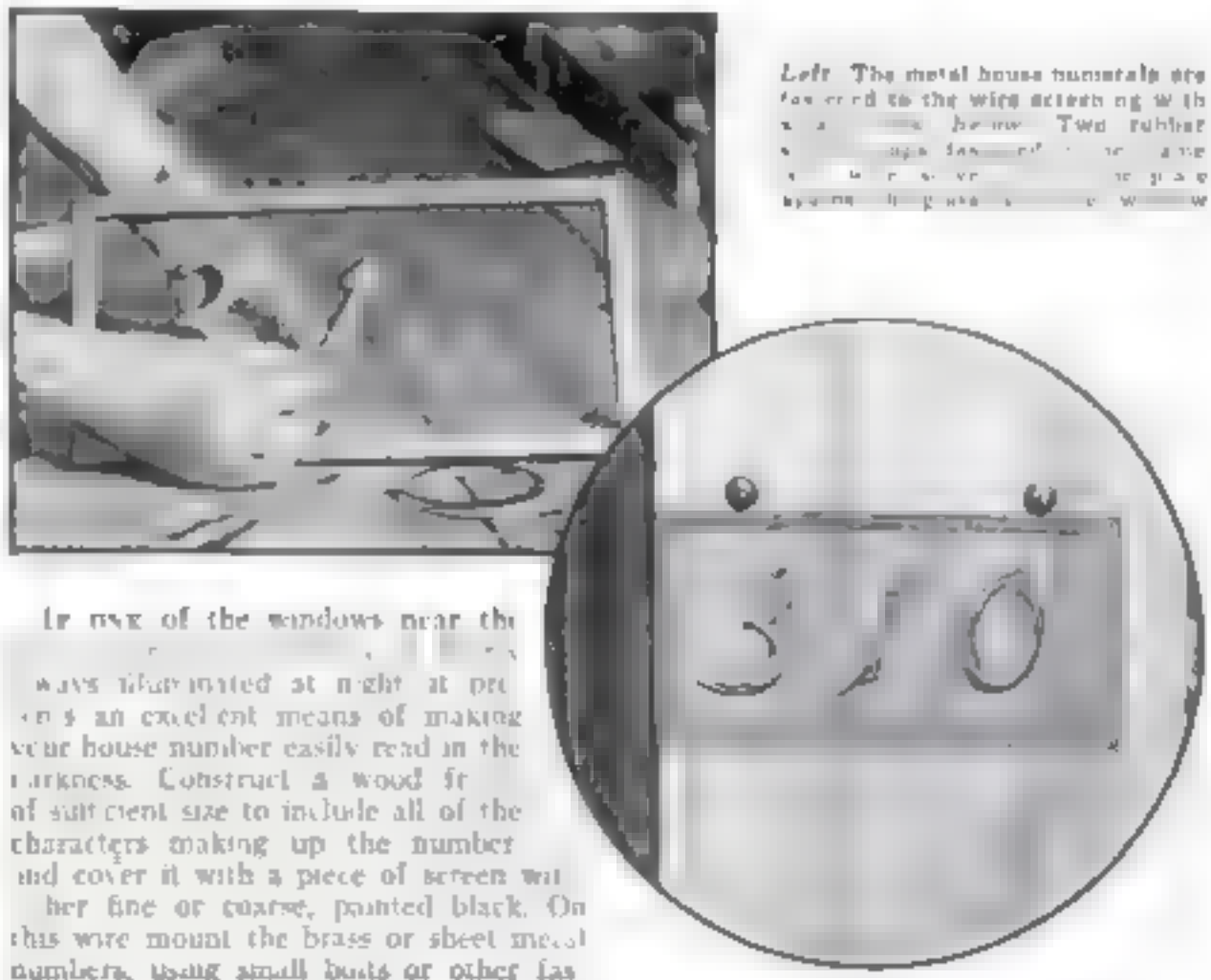
Apply a teaspoonful of water to each plant every two days.—A. E. LANDMAN.

IN APPLYING veneer, the amateur is often discouraged by the presence of spots caused by the glue's coming through the wood. This same thing, however, happens in large woodworking plants, often because of too thin glue. To remedy these darkened places, provided they are caused by hide glue, brush water on the spots, allow it to stand for two or three minutes, and then dry with blotting paper and a cloth. If the spots are still visible when dry, repeat the process. In applying the water, use no more than necessary and avoid wetting the adjoining veneer as it may tend to form veneer checks when the finish is applied.—C. A. K

CONSTRUCTS GROTESQUE BUGS AS HOBBY



HOUSE NUMBERS VISIBLE AT NIGHT



Left. The metal house numerals are fastened to the wire screening with [illegible] below. Two rubber [illegible]

IF ONE of the windows near the [illegible] always illuminated at night at pre[illegible] is an excellent means of making your house number easily read in the darkness. Construct a wood fr[illegible] of sufficient size to include all of the characters making up the number and cover it with a piece of screen wi[illegible] ber fine or coarse, painted black. On this wire mount the brass or sheet metal numbers, using small bolts or other fasteners. Attach the completed number plate to the window frame or to the glass itself so that light coming from behind will make the numerals stand out in silhouette. It may be found advisable to place a diffusing sheet—a piece of tracing cloth or onion-skin paper or something equally suitable—behind the numerals.

If it is not convenient to use a window you can place two or more lamp sockets behind the number. Use either candelabra sockets that will take small 5-watt pilot lamps, or standard medium screw sockets for ½- or 2-watt neon pilot lamps. These neon lamps, though not capable of giving great illumination, produce sufficient light to make the numbers distinguishable, if two or more are used. Their low current consumption makes it feasible to burn them all the time.—HERBERT WOOLSEY

BY USING a medicine dropper, glue can be applied in small quantities for model making. The dropper can be cleaned with hot water.—WILLIAM RIKERT

Above: The general arrangement plan of the 84-foot Knight Templar-designed Wanderer

Capt. E. ARMITAGE McCANN *tells how to set up the*

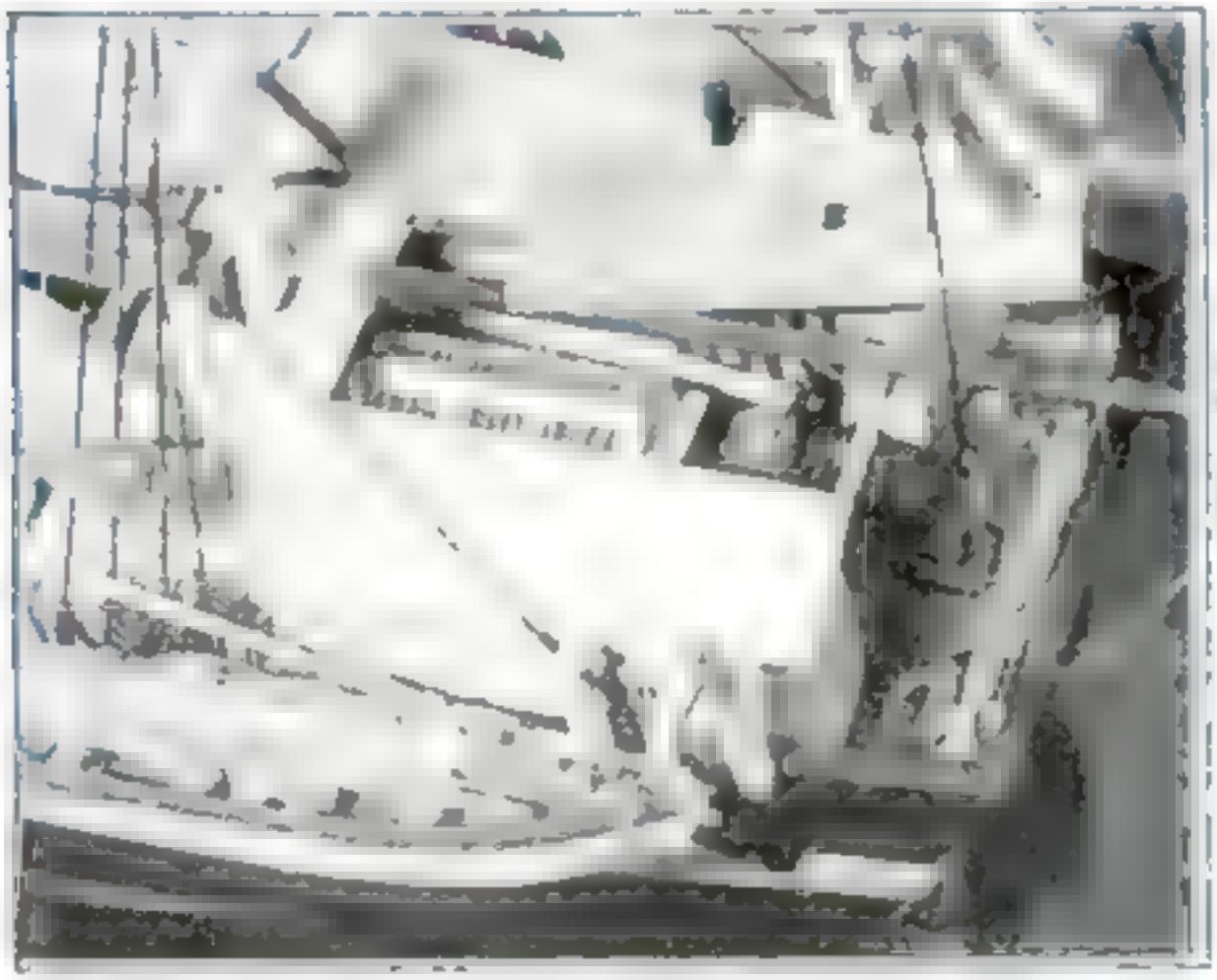
DECK FITTINGS *of our new ship model* "WANDERER"

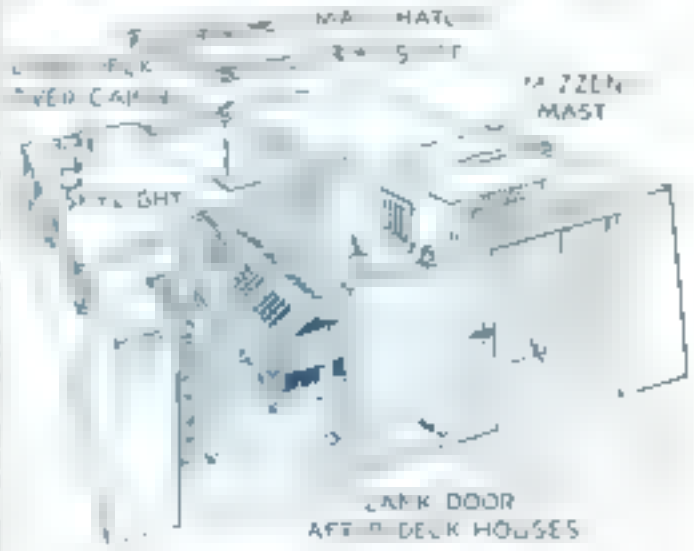
WITH the hull of our model of the American whaling bark *Wanderer* shaped and planked on the lines and offset table, we are ready to make the deck furnishings.

Those who missed the previous installment (P S M Apr '32 p. 75) can catch up quickly enough by sending one dollar for Blueprints Nos 151, 152, 153 and 154 (see page 110). As an additional aid the Popular Science Harvey Craft Club has assembled a kit containing all the raw materials for building the model except the paints. One of these kits, together with the four blueprints, will be sent to any address in the United States for $6.00 (see page 108).

The blueprints contain full size drawings of every part of the model, which is 27½ in. long over all. The scale of the model itself in relation to the original *Wanderer* is 1 in. to 1 ft.

The steering gear is of a type peculiar to whalers. Cut the end of the rudderpost square and on it fit a tiller as shown with sheaves on both sides and eyes at the end. On this erect two turned pillars to take the wheel and barrel. Neat little wheels can be bought, but one can be made from wood with brass wire spokes or cut from sheet celluloid. Through the wheel run a shaft and on the shaft mount a round wooden barrel. Set the whole steering gear assembly on the rudderpost. Hitch a rope to one eye, reeve it through a very small block bolted to the deck, carry it





A sketch of the deck houses looking aft. These are shown partly broken away so the skylight can be seen. A view looking down on the same parts is given in the remarkable photo at left

At the right is an extraordinary [illegible] photograph of the main life rail of Ca[illegible] Mc[illegible] and a model, and above is a sketch [illegible] construction [illegible]

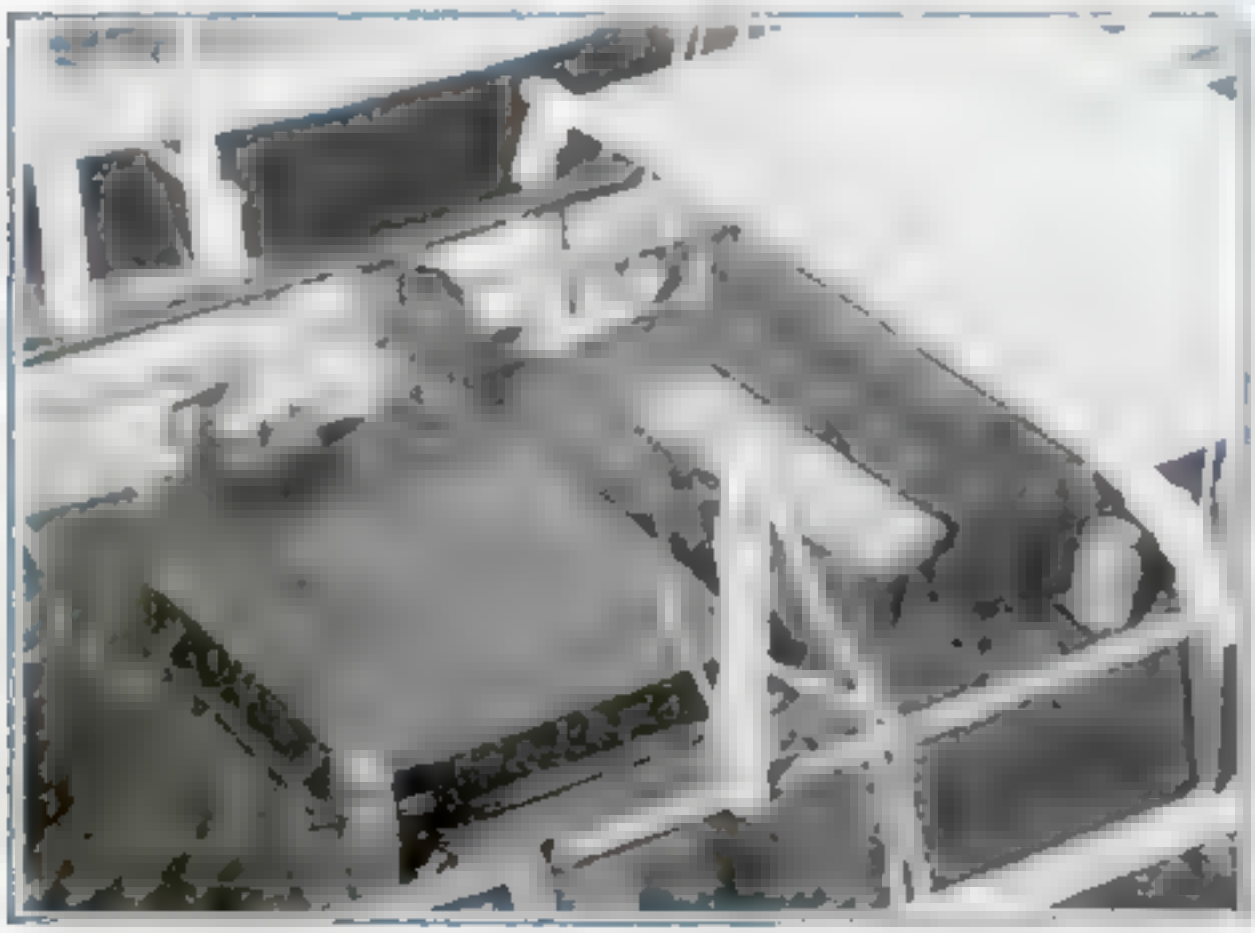
through the sheave on the tiller and three times around the barrel and do the same on the other side, brushing off lightly at the other eye. Turning the wheel should then work the rudder.

Next comes the cabin skylight and as detailed in the blueprints. I make this solid but it can be constructed if preferred, of ⅛ in. wood. The windows at the sides and ends should have celluloid to represent glass, and fine brass wire rods should be placed over them. The woodwork and wire are painted white.

The compass, which need not be large, was hung from the after end of the skylight inside, so that the helmsman could see it.

The after deck houses are the same on both sides. On the outside they follow the line of the bulwark, which gives them a slight inward slope. At the forward end they are slightly wider. The doors can be carved and painted with mahogany moldings. The windows should be recessed (or cut out if the deck houses are built of thin wood instead of solid blocks) and backed with glass or celluloid. The windows have bars across; the outside ones also have shutters which slide in rabbeted [illegible]

Across the two ends are beams extending right across. From the forward beam to the deck, amidships, there is a plank door or slide. Planking extends over all this to form a light deck, except for a small hatch opening so the helmsman can see the sails. I cut a large panel down the middle of the planking on my model so that one can see what is underneath, this panel slides in and out. Bore the hole for the mizzenmast before putting on this deck, and [illegible] deck [illegible] All [illegible] described is painted white.

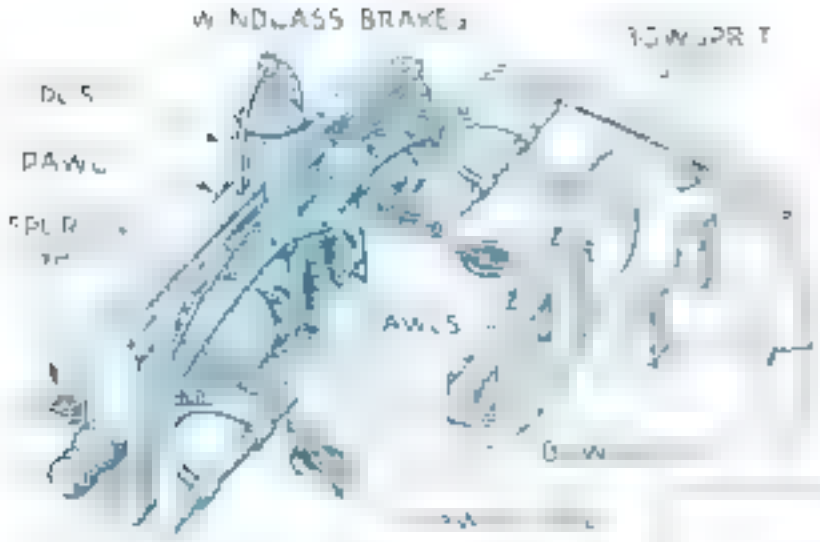


Sketch of the forward side of the try-works and, at left, a photo showing the after side

Bore holes a full ½ in. in diameter for the fore- and mainmasts in the correct positions and with the rake aft as shown on the blueprints.

The main life rail is composed of two topsail-sheet-bitt-posts as shown in the deck plan and in a separate detail. The bolster is half lapped into the foreside. Extending aft are two rails partially [illegible] resting on four turned stanchions. Four belaying pins should be set through this on each side. Drive an eyebolt in the deck at each side of the mainmast and [illegible] in forward of the mast place two eyebolts for the mizzen stay. Under the life rail two little pumps are set, these are shown in one of the detail drawings.

The main hatch is square with a camber on top. The individual hatch covers are marked on it, and rings are set in the corners of each to lift them by. Two or



The windlass for the anchors. To lessen the work required to build it the design has been somewhat modified and considerably simplified

three cleats are needed on each side for battening the covers down.

The try-works (where the blubber was boiled down) are built of bricks on an iron tray. The brick effect can be simulated by V-shaped knife cuts in a block of wood. On the fore side, the fire grates should be indicated with iron sheets sliding on a horizontal bar to cover them, and with an ash trough below. This structure is fastened to the deck with long iron angles as shown. From the roof project two short square chimneys (Longer ones were shipped to these when the fires were lit.)

At the fore side of the foremast is a companionway hatch leading to the crew's quarters. It can be cut from a block of wood and glued to the deck.

There is no fife rail at the foremast, but two eyebolts are needed at each side and also two eyebolts forward for the main sheet.

The windlass for heaving in the anchors stands about 1¾ in. from the foremast. As shown in the upper drawing on this page, the construction has been somewhat simplified. It consists of two curved wooden barrels set on a shaft which turns in one long and two short posts. At the inner ends of the barrels are ratchet wheels, and there is another ratchet wheel set in a slot in the center of the central post. On the outer ends of the shafts beyond the short posts are two smaller barrels. The tops of the outer posts are connected with a wooden brace.

Pivoted on the forward side of the central or samson post are long bars (windlass brakes) with handles at the ends, and from them hang pawls to engage the ratchets on the barrels and turn them as the bars are raised and lowered. There is another pawl on the afterside of the central post, over the center ratchet. The anchor chains come up through the hawse pipes, then pass around the barrels, and down through the spurling gates abaft.

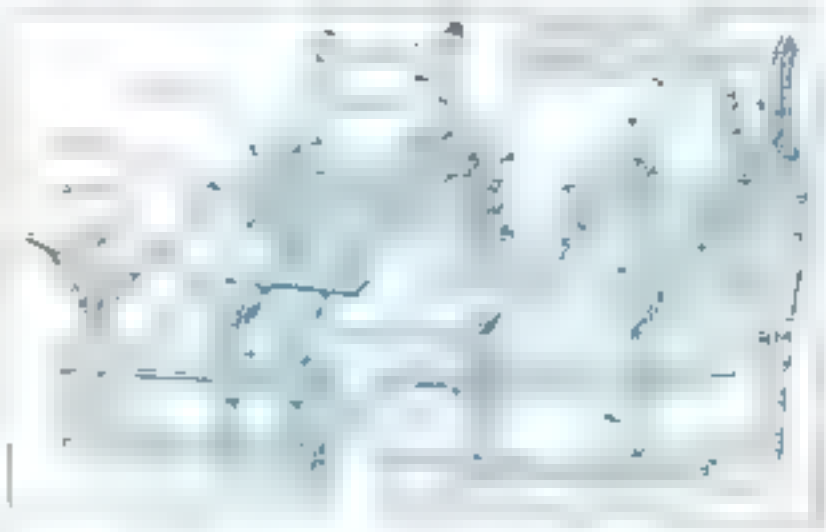
Placed 2¼ in. from the stem are two bowsprit bitts, ¼ in. apart, with a crossbar. The bowsprit fits between the lower ends of these posts. There are also four

COMPLETE PARTS

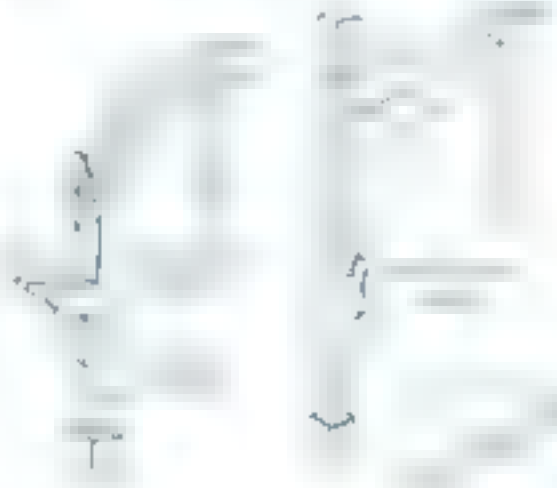
for building the
WHALER MODEL

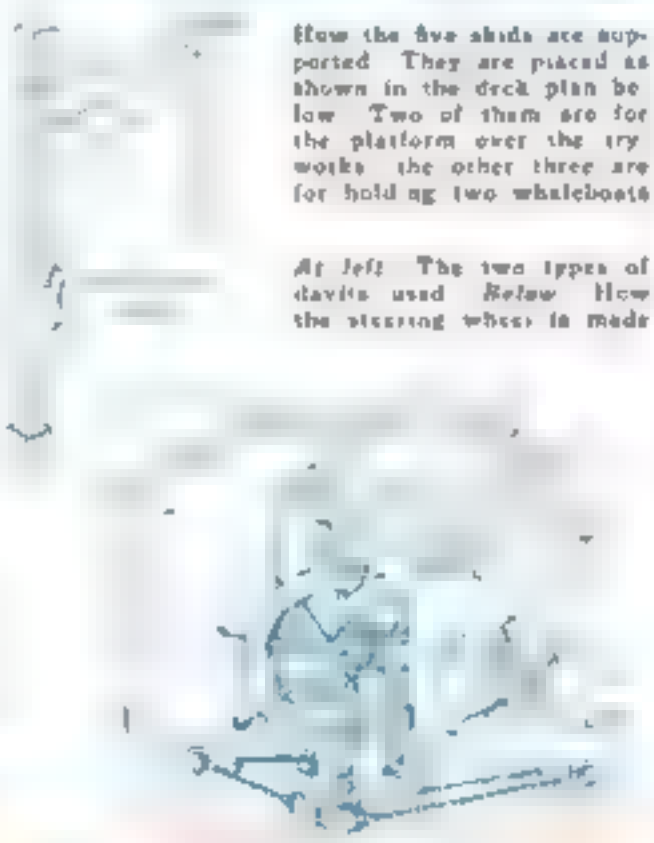
(except paints) can be obtained from the Homecraft Guild

See page 109



How the five skids are supported. They are placed as shown in the deck plan below. Two of them are for the platform over the try-works, the other three are for holding two whaleboats





At left: The two types of davits used. *Below:* How the steering wheel is made

sets of bitts in the positions shown on the deck plan. These are made of wood.

A blacksmith's forge, grindstone, and carpenter's bench should be placed on deck where indicated, and a cask should stand on each side of the try-works. On the starboard side near the after corner of the main hatch should be a post with a crossbar.

Some whalers had curved davits, others angular ones. The *Wanderer* had curved ones except for the starboard boat (possibly replacements). Any tough wood will do for these. It is advisable to make the curved ones in two pieces, half lapping them at the curve. They can be fret sawed in such a way as to leave cleats where needed, or the cleats may be nailed on afterward. At their ends drill three vertical holes as shown for the boat falls and one crosswise hole for the knotted end of the line. A more correct way is to make six holes and seize the end of the line to the lower block, but this is difficult.

The five skids which extend across the deck had better be fitted next. The two forward ones support a solid platform which extends right across to within ¼ in. of the bulwarks. It has two small square pieces nailed on to represent covers for the holes where the chimney extensions would come through. This platform may be made now, but should be left off until the rigging is done.

The three after skids are intended to support two whaleboats. Outside the boats there is a plank on each side.

The davits and stanchions are painted black to the top of the bulwarks, and white above; and the skids and platforms are white. Have the paint quite smooth but not shiny.

In the June issue Captain McCann will take up the subject of rigging the model.

The deck plan, a sectional view taken along the midship line, and the starboard side, all of which appear full size on our blueprint

Help *for* Car Workers

Practical Hints for Owner and Machinist

HERE is a way to make a water level indicator for your radiator. First solder a valve nut to the center of the radiator cap. Then drill a hole through center of radiator cap to take a brass machine screw. Drill a 3/32-inch hole lengthwise through the machine screw. To the top of vertical wire fasten a small piece of dowel rod colored red. File away one side of a valve cap and fit a piece of glass. Fit the cork at the lower end of the wire so it will support the indicator near the top of the valve cap when the radiator is full.

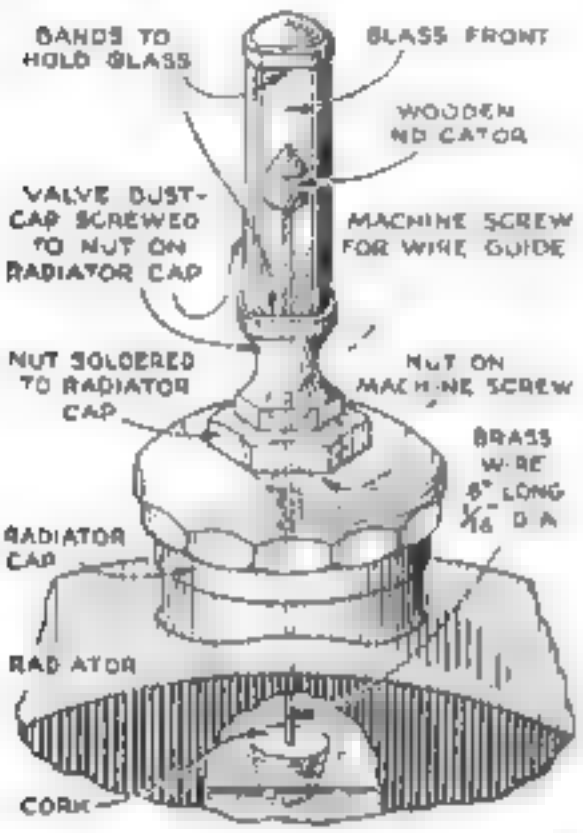


Fig. 1. Indicator of old parts can be assembled as shown to register water in radiator

Save the Gasoline

ON SOME cars, the gasoline tank is filled through a piped opening and air pressure may back up in the tank and spray gasoline out. A cure for this trouble is shown in Fig. 2. Take a two-foot length of quarter-inch copper pipe and bend it into a curve. Push it into the filler hole so that the inner end curves up. Wedge it in place with the nozzle of the hose. The copper pipe provides an unimpeded passage for the outflowing air.

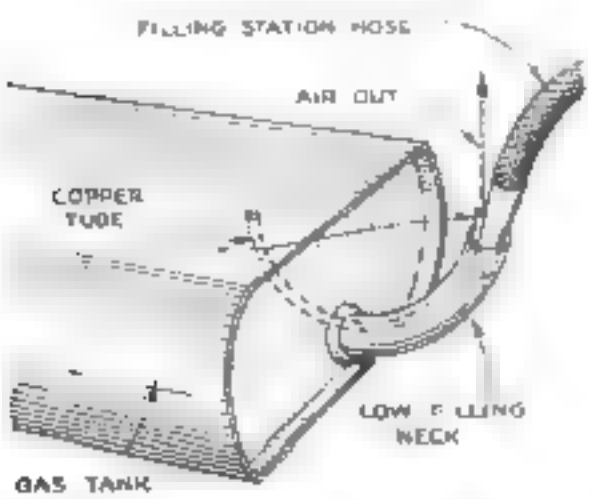


Fig. 2. Copper pipe, curved inside gasoline tank's filling pipe, keeps gas from escaping

WIN A $10 PRIZE

Each month we award $10 for the best idea sent in for motorists. This month's prize goes to W. M. Overly, Indianapolis (Fig. 1). Contributions are requested from auto mechanics, and if printed will be paid for.

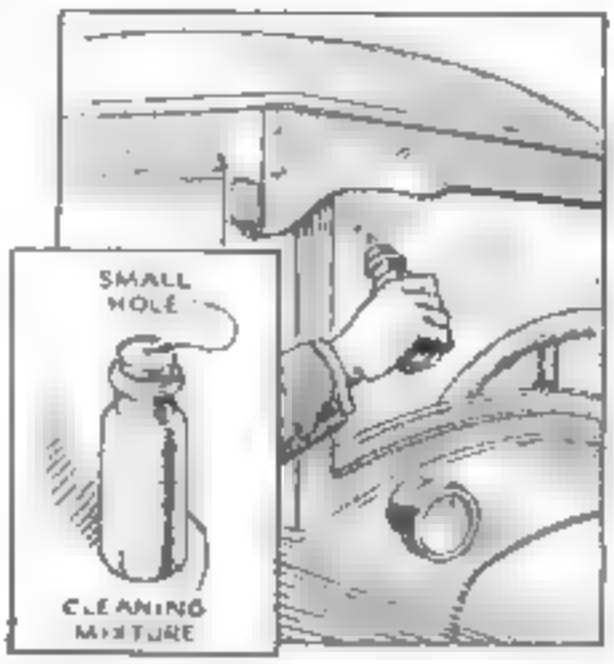


Fig. 3. Soapy water containing a little vinegar is squirted on the windshield to clean it

To Clean Windshield

SOAP and water usually will clean the windshield, but it is difficult to do the job without spilling soapy water on the body. Figure 3 shows a solution of this trouble. Fill a bottle with soapy water containing a small amount of vinegar. Fit the bottle with a cork grooved on one side or with a small hole burned through the center with a red-hot wire. Whenever the windshield needs cleaning, dash a few drops of this mixture on the glass and polish with a clean dry cloth.

Emergency Fan Belt

IT OFTEN is possible to drive a car for miles after the fan belt breaks without causing the radiator to boil if the going is level. In mountainous country in hot weather the fan is necessary. If the belt goes to pieces try cutting a fairly broad section from an old inner tube and spring it around the pulleys. This will drive the fan till you can get to a service station and install a new belt.

Fig. 4. Section cut out of inner tube can be used in case of a worn fan belt

Skid Chain Cleaner

HANDLING chains is a dirty job at best. Figure 5 shows a way to clean chains without even getting your hands wet. Take two pails, one large one small, and perforate the smaller with a number of holes in side and bottom. Put the dirty chains in the small pail and fill the large pail with water. Dip the small pail into the large one several times and all the mud will be washed off the chains into the lower pail. In case the chains are covered with road tar or road oil, fill the large pail with kerosene and allow the smaller pail containing the chains to stand in the kerosene overnight. This treatment will in most instances free the chains of all oil and tar.

Fig. 5. Ringed and perforated small pail make handy apparatus for washing mud from chains

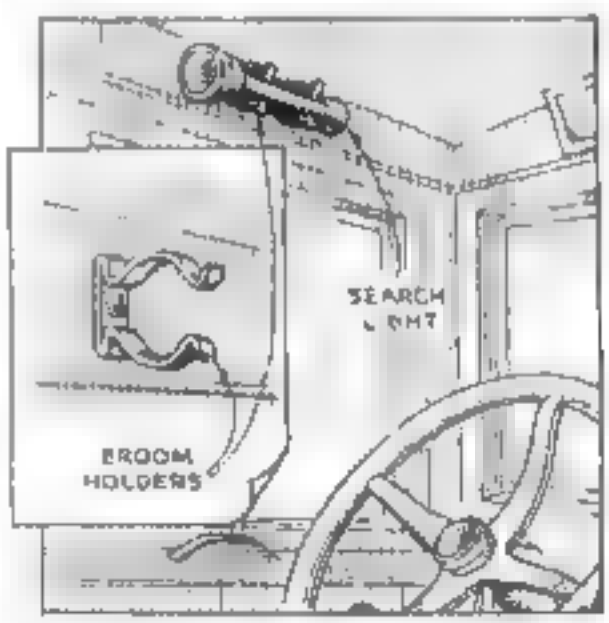


Fig. 6. Flashlight is held in a convenient position by broom holders fastened above the door

Flashlight Holder

IT IS good practice to carry a flashlight in the car at all times, but tossing it into the tool box with the rest of the tools is one way to ruin it. The jouncing tools will bang it to uselessness in short order. Figure 6 shows a good way to carry the flashlight. Fit two broom holders over the door or at some other convenient point in the upper part of the body. Being out of the usual line of vision, a flashlight in this position is not likely to be stolen. Be sure it fits snugly, so vibration will not dislodge it.

This Rock Garden Fishpool

Costs Less than Five Dollars for Materials

By Ormal I. Sprungman

TWO sacks of cement, a couple of dozen pails of sand and gravel, a short length or two of 1½-in. pipe a few pipe fittings, some hay wire, and a little patience will put a rock garden fishpool in your own back yard—and all the materials you need to buy won't cost as much as a five-dollar bill.

The fishpool illustrated was built in the rear of a city lot of average size. The work required less than eight hours. Shaped like a huge dumb-bell, the pool has an over-all length of 9 ft. and a width of 5 ft. It holds 12 in. of water at the deepest point and 8 in. at the shallow ends. The two "bowls" are connected by an 18-in. channel, part of which contains a shallow built-up arm intended especially for feeding the fish.

A shallow trench is dug for the pipe that carries off any overflow and allows the pool to be drained

Before cementing the excavation, make sure that the ground around the edges is perfectly level. Use a straight rod and a spirit level

The concrete, mixed to a rather stiff consistency, is patted on the bottom and sides of the pool with a gloved hand until 2½ or 3 in. thick

After an outline of the pool has been marked on the ground, a trench should be dug for the drainage pipe. This pipe should run from the center or deepest part of the pool to some place in the yard where the water can be disposed of conveniently. For example, the pipe can terminate in a reasonably large hole filled loosely with stones. At the pool end of the pipe, an elbow is fitted, and into this a short upright pipe is screwed, extending to within about 2 in. of the top of the concrete. Being open at the top (or finished off with an elbow as shown for neatness), this upright pipe will allow any overflow to drain away, yet it may be removed temporarily when it is desired to empty the *(continued on page 111)*

WELDING *Cuts Cost*

OF JIGS AND FIXTURES IN SMALL MACHINE SHOPS

By Hector J. Chamberland

Those machinists and toolmakers who have held their jobs during the past two years are the ones who have demonstrated in various ways their ability to save their employers' money by the application of new and better methods.

In the small machine shop where work is usually taken under contract, there are many ups and downs, especially when estimating the tooling end of a proposition. If, for example, a contract involves the construction of twenty-five machines, the cost of producing the machines' parts would vary but little among all bids; the main difference would be found in the expenditures for equipment needed to produce these parts, or "tooling up," as it is commonly termed in the machine shop. And it is just here where money can often be saved by the expert use of welding.

Small jigs and fixtures are generally made from a solid piece of machine steel to which all necessary parts are fitted with dowel pins and bolted with countersunk screws. If the work is of medium or large size, the first thing needed is a pattern for each jig and fixture and the average semiautomatic machine may require six or eight of each. If the cost of these is figured on the basis of $2.50 an hour for labor and overhead, this represents a substantial outlay. On the other hand, if the fixtures can be made by welding machine steel plates together and welding as many as possible of the other necessary parts to them, the cost will be reduced greatly. This is true even if the machine steel and labor costs forty percent higher than a casting, because the difference will be offset one half by the time saved in preparing the welded job for laying out.

At *A* in the accompanying drawings is shown a rocker arm casting which is to be bored with the welded jig detailed at *B* and shown assembled at *C*. It is taken for granted that the stock has been ordered and delivered cut to size plus finishing allowances for width and length. The first operation, therefore, is to square all sides of the parts. If the stock is not parallel, it should be surfaced on the rotary grinder. All edges should then be trimmed on the shaper to a 45-deg. angle, the chamfer being from ⅛ to 3/16 in. wide; this is done for convenience in welding.

Assembling a jig of the type shown in the assembly drawing marked *C* in the group below. The parts are held with clamps and angle irons

The parts are now ready to be assembled. The work should be done on a surface plate, but not the one used for laying out. With a set of angle irons made as at *D* and a sufficient number of clamps *E*, the frame is put together as shown at *C*. The bottom plates are then clamped in their proper locations with all the angle irons inside. This should result in a perfectly square unit ready to be welded.

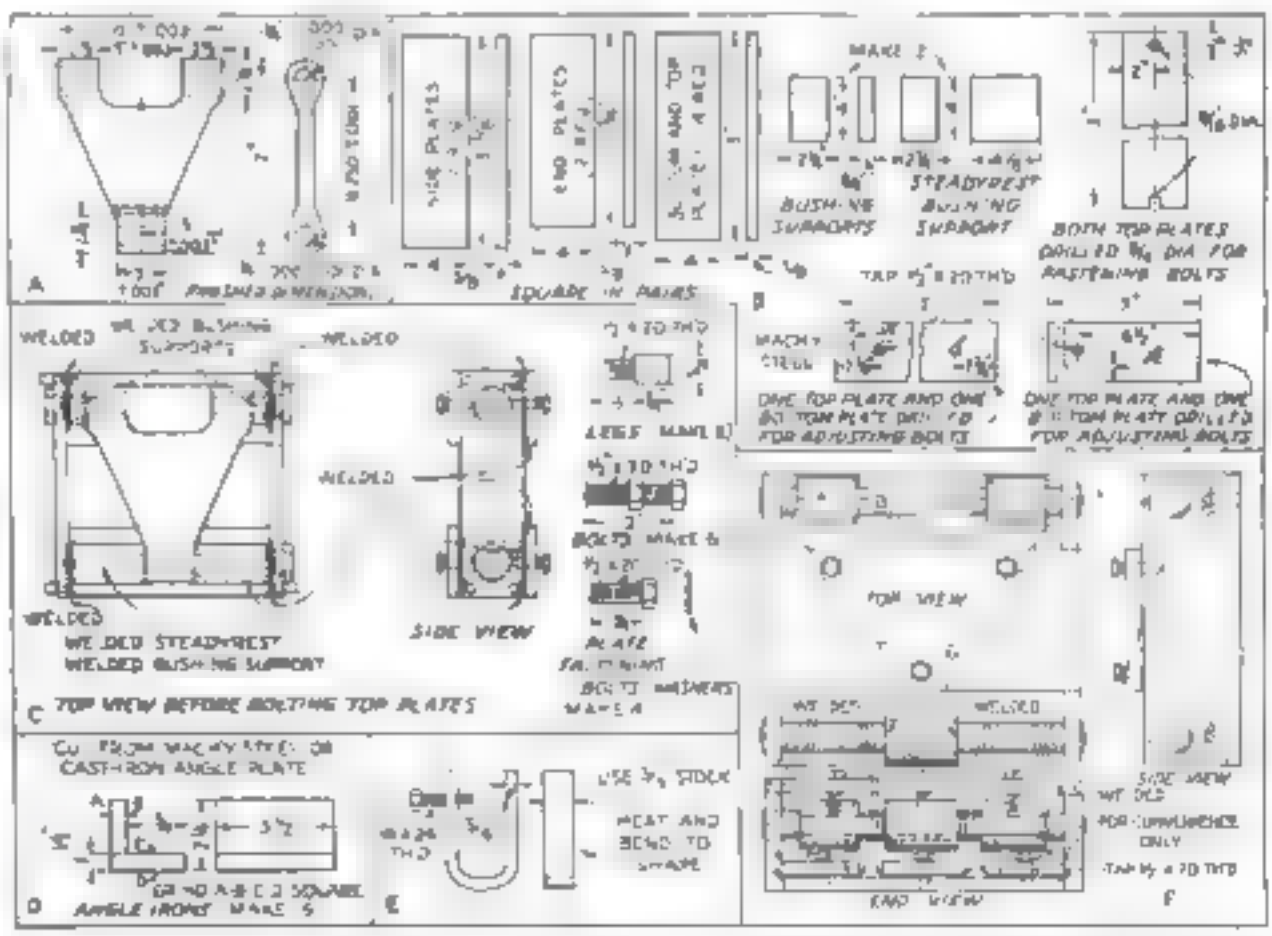
Under the restrictions of existing conditions, welding operations are frequently handled by a blacksmith or a tinsmith, but it makes no difference who does it, as everything is in readiness. Before the torch is applied, the inside of the frame should be lined with sheets of heavy asbestos. This lining, together with a sufficient preheating of each location to be welded, will prevent possible distortion during the cooling process; nevertheless, any slight error in this respect will cause no trouble, as all surfaces have to be spotted for the bushing heads.

The frame at all times should be in such a position that the molten metal will spread freely and not too quickly and thus produce an even and solid job. The four corner joints should be welded, also the outside joints of the bottom plates, then, by removing the angle irons, the inside plate joints may be welded.

After the frame has been left to cool, the bushing supports are fitted in such a way that the welding of the bottom plate does not interfere. The supports are clamped to their respective locations and then welded at every possible joint. If a good job is done on these pieces and also on the bottom plates, there will be no strain while boring, since the end plates of the frame are fitted inside the side plates. The assembly can be relied upon to be as rigid as a cast-iron jig.

The toolmaker will find, after smoothing the welded rough spots with a die-sinking hand grinder, that he has a clean job. He can proceed to square all sides by filing the legs, and then is ready to lay out the locations. As mentioned before, this procedure may cost from thirty-five to forty percent higher until this point, but with a casting it is necessary to do some surfacing here and there before any attempt can be made to lay out. The welded jig saves this time so that in the end from seventy-five to eighty percent of the pattern cost is eliminated by this method of construction.

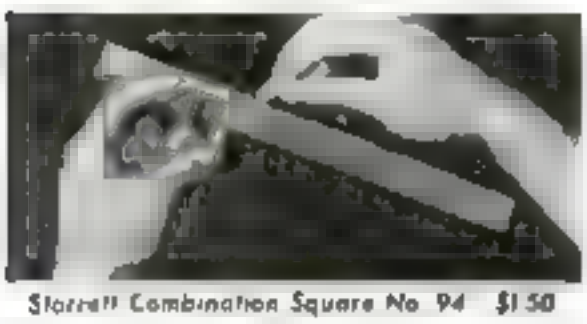
A welded milling fixture for the same production casting is shown at *F*. The process of making it is identical to that of the jig, only in this case the top plates are welded. Lining-up bars are used for



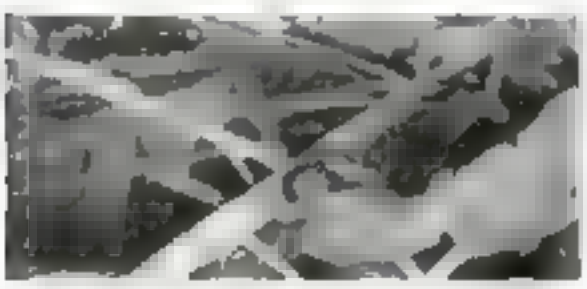
The rocker arm casting is shown at *A*, the parts for the boring jig at *B*, the assembly and some other details at *C*, the angle irons and clamps at *D* and *E*, and a milling fixture at *F*

Tools You Need —and can afford!

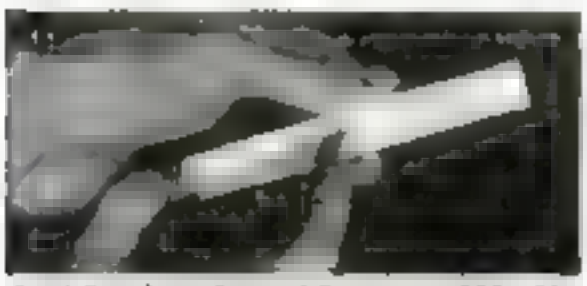
Starrett Micrometer No. 230—$10



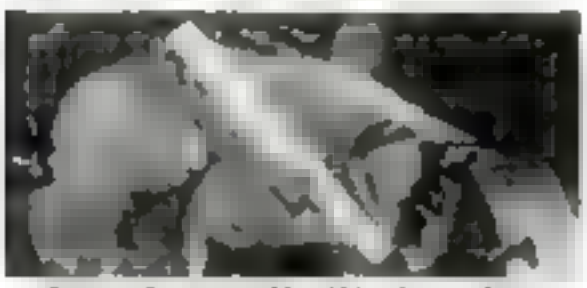
Starrett Combination Square No. 94 $1.50



Starrett Steel Tape No. 530 50 ft. $2.90



Steel Rule (with Decimal Equiv.) No. 305 90c



Starrett Protractor No. 490—9 in.—$5.40

Starrett Drill Point Gage No. 22-C—$2.50

It's the simple little tools that make or break the ordinary job. Have too few of them, or some of poor quality, and you have trouble — trouble at every turn.

Trouble that's not necessary at all. Of all the handy Starrett Tools on this page, there are only two that cost more than $3. Yet every one of them is the finest of its kind. They have permanent accuracy, naturally, like every Starrett Tool. But, in addition, they have the balance — the finish — the feel that machinists look for — *and find*—only in a Starrett.

Own the Best

Plan now to own the best tools, and only the best. The reward is the satisfaction of cleaner, quicker work.

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World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
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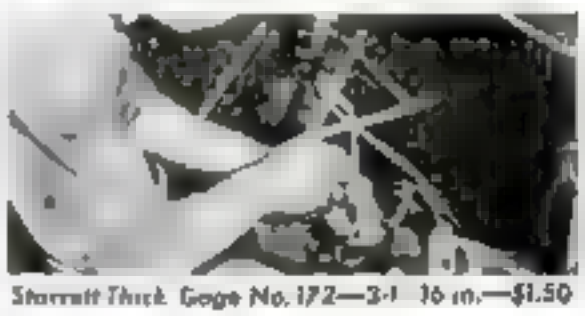
Starrett Hook Rule & Depth Gage No. 236H $2.50

Starrett Dividers No. 92 6 in.—$1.45

Starrett Hacksaw Frame No. 750—75c

Starrett Universal Scraper No. 194—$1.25

Starrett Calipers No. 73 —2½ in.—80c



Starrett Thick Gage No. 172—3-1 16 in.—$1.50

Use Starrett Tools

accuracy between bores and faces, so that when changing to a new casting, the bottom adjusting screws have to be reset each time. Allowances are also made in the design of the fixture so that faces A^1, B^1, C^1, and D^1 can be milled in one operation with a gang of side mills 7 by ½ in. After adjustments have been made to mill the first piece, it is only necessary to use a gage block between D^1 and E^1 to locate the others. To mill faces F^1 and G^1, the position of the fixture should not be altered, but the new gang of cutters set to revolve in the opposite direction and the milling done accordingly. In the case of this second milling operation, a gage is also used as previously outlined after the first piece has been finished to within required limits. It is understood, of course, that No. 1 castings are used and that they run very even and smooth.

To obtain accurate results with any jig, whether welded or not, a common twist drill should be used first and followed by a three-lip drill. An adjustable reamer set .001 in. undersize will then hold the job safe for finishing with a standard hand reamer.

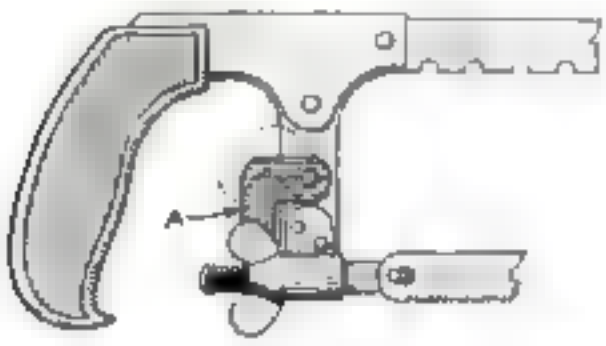
If a jig or fixture is required that is to measure from 7 or 8 in. to 24 in. either way, it is well to make a careful study to determine if it is not much cheaper to do some welding than to make a pattern. Of course, we have in mind here the average shop, which is, so to speak, a sort of experimental station where every little kink amounts to a whole lot. With mass production, especially where thousands of parts are produced daily, it makes very little difference what it costs to get ready for production.

In the smaller shop tool costs often can be greatly reduced by the application of time and material saving methods and welding plays an important part in this respect.

A variety of other ways to reduce costs by welding will be described by Mr. Chamberland in another article scheduled for early publication.

CATCH KEEPS HACK SAW TIGHT IN ITS FRAME

WING nuts on hack saw adjustments often vibrate loose while cutting through a particularly hard piece of metal. This may be prevented by riveting a small L-shaped piece *A* in the position shown. The fastening should be loose enough to serve as a pivot for the locking piece, yet sufficiently tight to hold it firmly in place against the nut. The locking piece is swung out of the way of the wing nut when it becomes necessary to adjust the blade.—NORMAN V. DAVIDSON.



When in place, the locking piece prevents the adjustment nut from vibrating loose

Old Bill *Says* . . .

IT'S the start of a job that counts. That is why it pays for both foreman and mechanic to study the designer's ideas and even temper them with their own, provided their combined ideas will build into the design add tional qualities of usefulness and practicability.

The only way to tell if a milling machine arbor is true is to indicate it at the extreme end while in the spindle and free from the arm support.

When you have to work on a machine that is not operated regularly, don't take it for granted that someone else will look after lubricating it. If you do, it will never be properly oiled.

By centering a centerless spiral end mill in a collet and holding it in place with solder it is possible to grind it on an ordinary tool grinder.

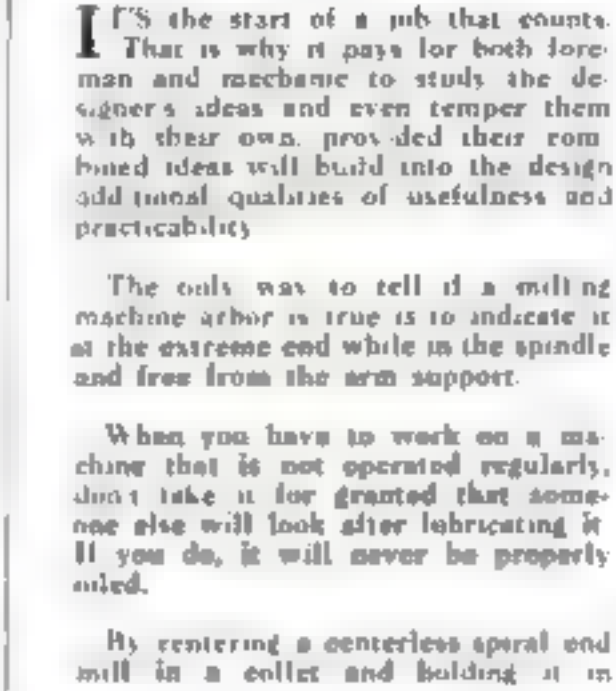
The careful removal of burrs from all machined parts is a good step in the direction of safety.

Scaling blueprints is always a dangerous practice and it may lead to costly errors.

EASILY MADE MOLD FOR LEAD HAMMERS

TO MOLD lead hammers for garage or machine shop use and to remodel old hammers when they get battered out of shape requires only a few minutes' work when the method illustrated below is used.

Two open-end and slightly conical ferrules are made from a piece of old fender or other scrap stock as at *A* and *B*, the seams being welded. A semicircle is cut in the large end of each ferrule as indicated so that they will come together edge to edge around a suitable short piece of pipe *C*, which serves as the hammer handle; however, where the semicircles



The mold consists of two slightly conical ferrules clamped around the hammer handle

are cut out for the pipe the fit should be loose enough to allow the excess lead to escape during the casting process and thus avoid filling the hollow handle.

One end of the pipe handle *C* is split with a saw, and the tabs are bent out. Then the mold is clamped together, with steel plates to close the ends of the ferrules, and the lead, which can be salvaged from old batteries, is poured in through the pipe handle.

If the ferrules are reasonably smooth on the inside, they can be slipped off easily when the lead cools.—W. J. FINK.

LARGE SWEEPING PAN CUT FROM CARTON

CONFRONTED with the job of sweeping out a large number of rooms in a new building after the carpenters had finished, one of the workmen constructed what he called a "lazy man's dustpan." He merely cut away a portion of the side of a cardboard shipping carton and tacked on a stout stick to strengthen it, as illustrated. The box was pushed around with the foot while the shavings, sawdust, and scraps of wood were swept into it with a large floor brush.—F. W. B.

WHEN machining thin tubing or thin hollow castings in the lathe, the work will often begin to vibrate and ring like a tuning fork, causing the tool to chatter even if it is properly ground. This can be prevented by "damping" the vibrations. For example when turning the outside of the work, cut a piece of old belting and wedge it inside the tube or casting. If boring a hole, snap sections of rubber inner tube around the work.—W. W. LYON.

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"Then, I want a projector capable of showing those movies with the brilliance, beauty and smoothness they'll deserve. A projector that will function perfectly without attention during the show."

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Your dealer would have exactly what you wanted in Ciné-Kodak K and Kodascope K. Instant interchangeability of lenses, built-in winding crank, two finders—make Ciné-Kodak K a movie camera that is ready to take brilliant pictures under all conditions.

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See these companion "K's" at your Ciné-Kodak dealer's. Eastman Kodak Company, Rochester, N. Y.

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1. Half-speed at the press of a button doubles the exposure time
2. [illegible] Wide Angle, Telephoto lenses instantly interchangeable
3. Adaptable for making Kodacolor.
4. Winding crank permanently attached and always ready for use
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6. Easy to carry and use because of light weight and convenient shape.

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1. Improved optical system, special [illegible] watt lamp.
2. Receptacle for plugging in room lamp so that when Kodascope lamp switch is on, the room light is off
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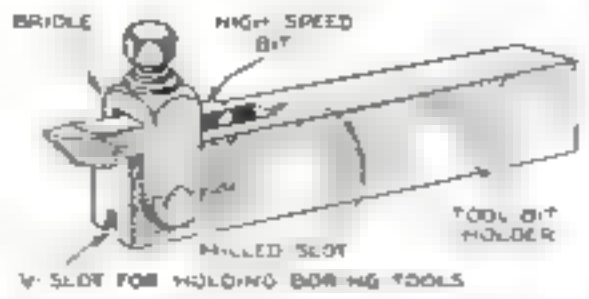
6. Hinged door on lamphouse for easy cleaning of lamp and condenser.

Ciné-Kodak... *Simplest of Home Movie Cameras*

HOLDER FOR HIGH-SPEED TOOL BITS

The ordinary bridle tool holder, which has a vee in the top for holding boring tools made of round stock, may easily be converted into a high-speed tool-bit holder that in some respects is preferable to the various standard holders, especialy for cast iron and brass. This is done by milling a shallow slot as shown in the bottom of the holder at the end that carries the bridle. If it is desired to use a 5/16-in tool bit, the slot should be slightly wider than this so that the bit will slip in easily, but not wide enough so that it can shift from side to side. The slot may be about 3/8 in. deep and cut far enough back to take full-length bits without striking the radius left by the cutter at the back end of the slot.

In use, the bridle is turned over the end of the holder so that the screw comes on top of what was formerly the bottom of the holder. The tool bit may now be laid in and held securely by the set screw and the sides of the slot. This in no way detracts from the usefulness of the holder for ordinary boring purposes since the bridle can be quickly turned back to its original position.—T. E. Murdock.



An ordinary bridle holder for boring tools modified so as to take high-speed tool bits

SLOTTED SUPPORT HELPS IN LAYING OUT STEEL ANGLES AND TEES

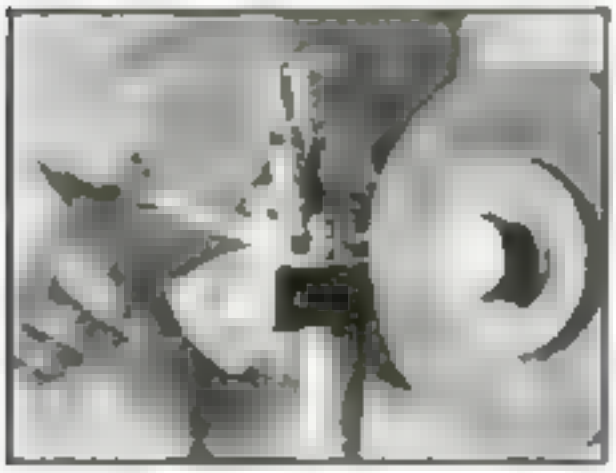
Laying out steel angles and tees in the machine shop can be simplified considerably by the use of the holder illustrated above, which is secured to the top of an iron horse by means of two or more 5/8-in bolts. It is simply an 18-in. or longer section of a 6 by 6 in. tee, in which several gaps have been cut in the vertical section. These may be of varying widths to receive different thicknesses of metal. With one flange of a long tee or angle inserted in one of the gaps, the piece is held firmly for laying out, and two pieces may be lined up together for marking as a pair as in the photograph above.—K. Newtander

FEED SACK COLLECTS DUST FROM SANDER

At a disk sander or any other small machine designed to blow fine dust from the operation through a tube to the floor it is an improvement to add an extension to the tube as shown at the right and tie a feed sack over the end. The bag must be porous enough to allow the air to escape, leaving the dust inside. Sweeping about the machine is reduced to a minimum, and the dust is always sacked ready for removal.—C. J. C

Using a feed sack at a disk sanding machine to collect dust otherwise blown on the floor

HOW TO HOLD PINS FOR GRINDING THE ENDS

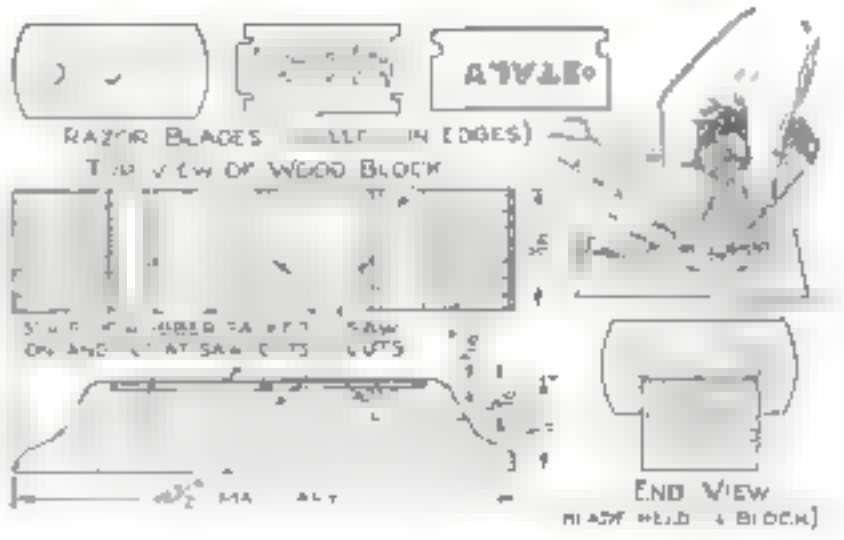


A sheet metal guide clamped on upper jaw of pliers to give firm grip on pins and screws

Short pins, screws, and other small cylindrical parts which have to be ground by hand on the ends are often held with the aid of a pair of pliers, but they are practically certain to slip around to some extent because the jaws of the pliers are not parallel. I cured this fault recently in a simple but effective manner by using two small machinist's clamps and a narrow strip of sheet metal. A hole large enough to receive the screws which had to be ground was drilled near the end of the strip of sheet metal. The piece was then bent at right angles at two points so that, after I had tightened one clamp on the upper jaw of the pliers, I could place the sheet metal strip between the jaws of this clamp and hold it fast against the clamp screws by means of the second clamp. This made a rigid holder for grinding heads from screws.—W. H. Moore

ERASING SHIELDS MADE FROM RAZOR BLADES

An excellent set of erasing shields for use in correcting or altering drawings can be made from safety razor blades. An old-style double-edged blade with three holes, a double-edged blade of the new style, and one of the single-edged blades used in the self-stropping type of razor contain between them a sufficient variety of openings to allow almost any type of line to be erased. It is necessary, of course, to dull the sharp edges on an oilstone.



Three types of blades that give a variety of openings, and a neat looking block faced with rubber in which to keep them

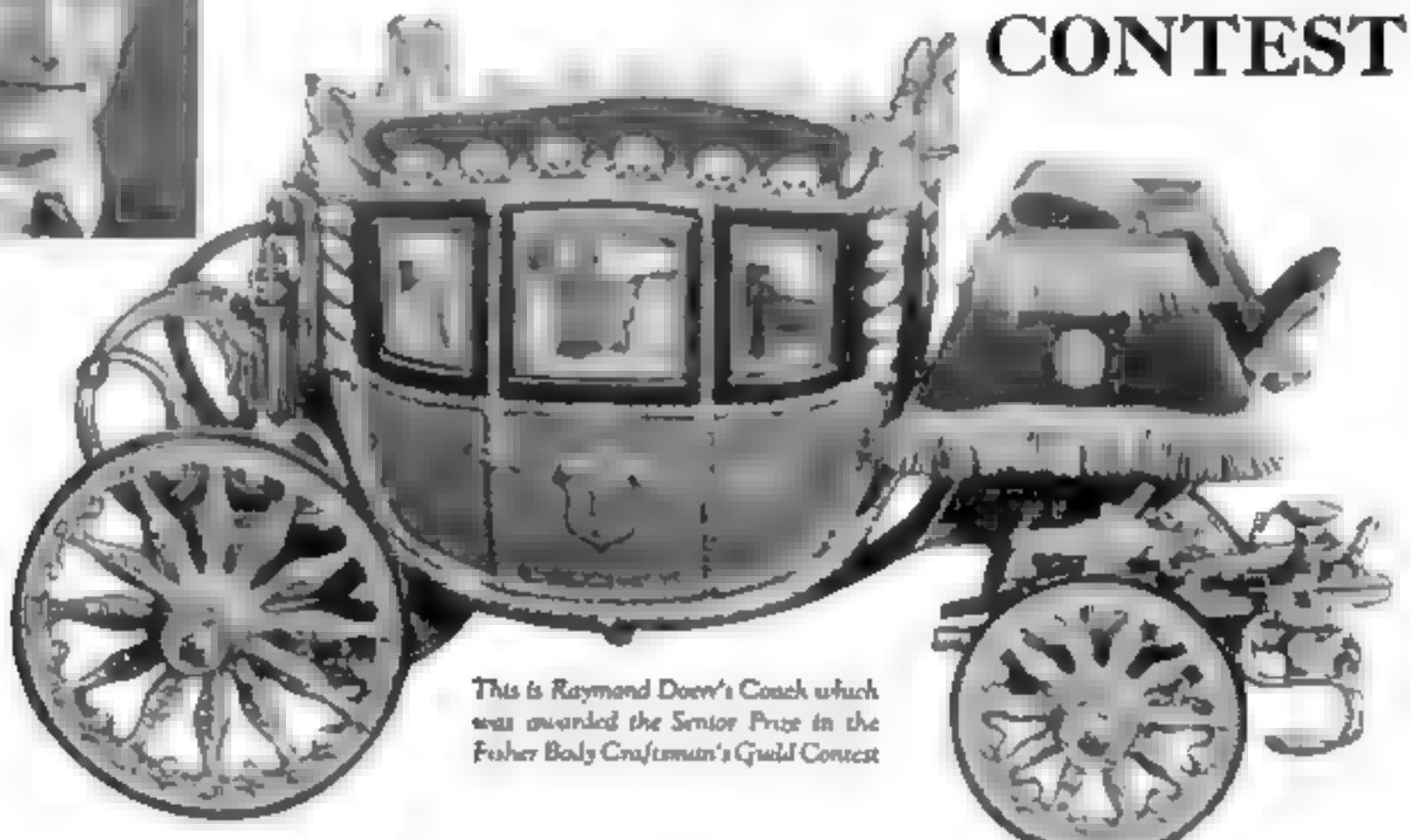
A convenient holder for the three blades can be prepared from a 13/16 by 1 1/16 by 4½ in. block of soft wood, shaped as shown and grooved with a saw. A strip of rubber is tacked over the grooves and then cut through directly above the saw kerfs. The block itself may be oiled, varnished, painted, or left in the natural wood color, as desired. The [illegible] should be applied before the rubber.

When the blades are pressed through the cut rubber into the grooves, they are held firmly and yet are ready for instant use. If a vertical board is being used, the holder may be screwed to it or placed on a stand alongside, whichever proves more convenient.—K. G. Staal.

PLASTIC WOOD

HELPED HIM WIN

$5,000 *Coach Modeling* CONTEST



This is Raymond Doerr's Coach which was awarded the Senior Prize in the Fisher Body Craftsman's Guild Contest

RAYMOND DOERR *says:*

"*Only* PLASTIC WOOD *Meets the High Standard set by the Master Craftsman*"

In the construction of my Napoleonic Coach which was awarded the senior prize, a five-thousand-dollar scholarship, in the recent Fisher Body Craftsman's Guild Contest, Plastic Wood came to my aid in many instances. It was indispensable in creating a perfect model.

I have found that imperfections in all sorts of model work may be corrected in a surprisingly successful manner by the use of Plastic Wood. Its excellent adherent quality and its malleability make it unexcelled as a binder and filler. I would like to say that Plastic Wood meets the high standards demanded by the Master Craftsman and facilitates the making of perfect models to an amazing degree.

Very truly yours,

(signed) RAYMOND S. DOERR

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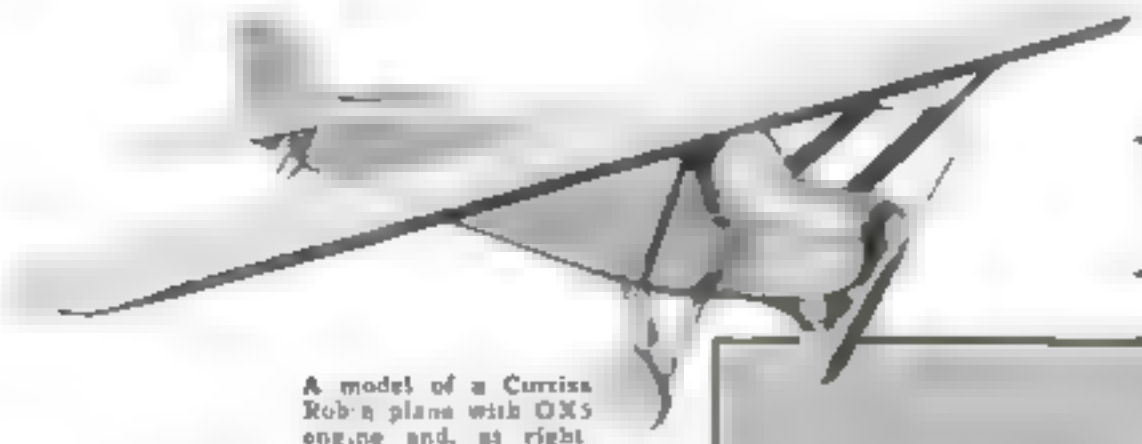
Plans by DONALD W. CLARK for a simple model of a popular

Cabin Monoplane

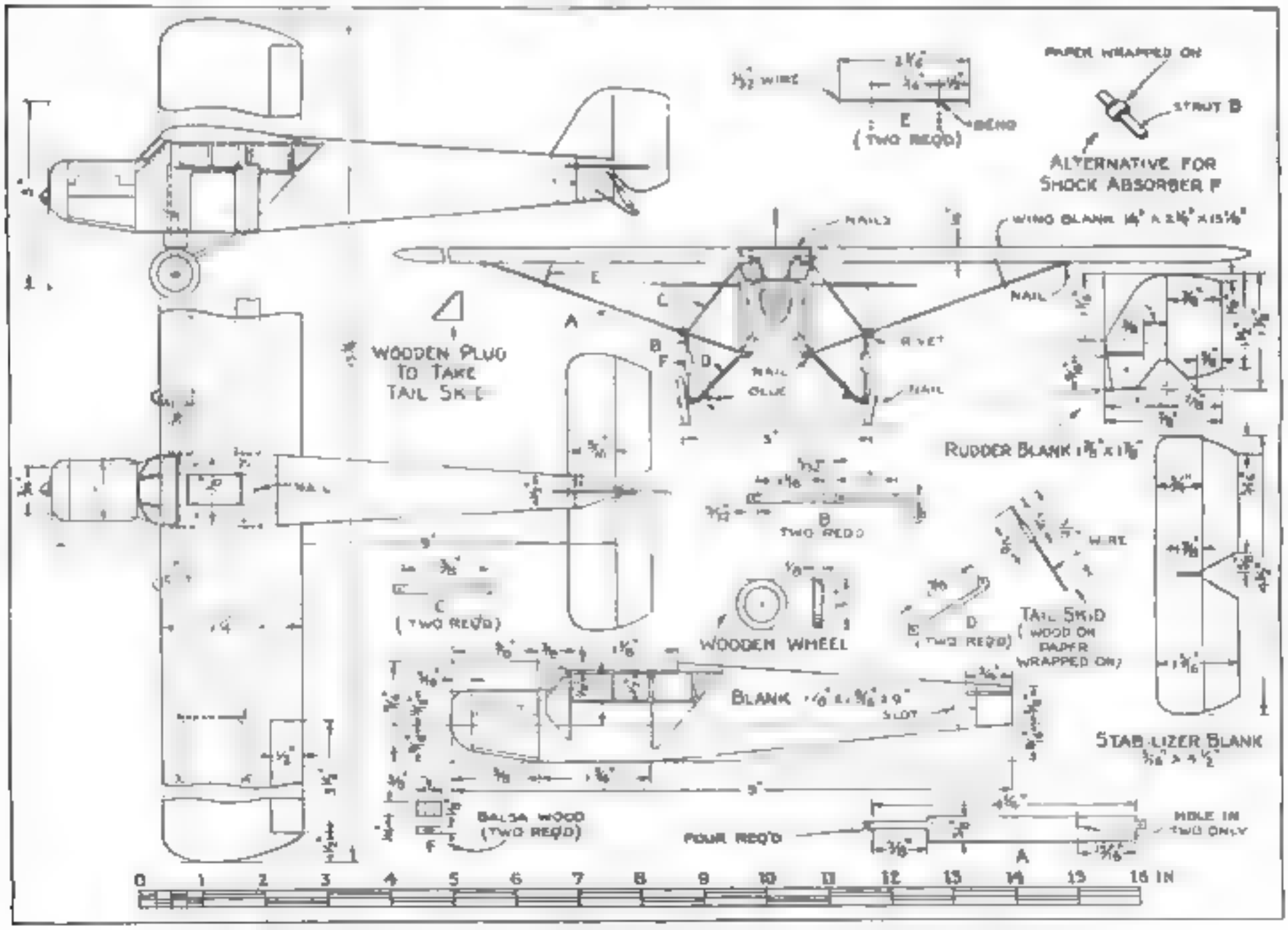


A model of a Curtiss Robin plane with OX5 engine and, at right, the few parts needed

THE graceful lines of the Curtiss Robin monoplane with OX5 engine are an incentive to the experienced model builder who enjoys making a neat, clean-cut job, and its simplicity will appeal to beginners who wish to avoid, in their first model, the difficulties involved in representing a radial engine. It is a reasonably easy task to make this model if the drawings are followed closely and the parts shaped accurately before assembly

Cut out the wing in one piece from white pine, balsa or other soft wood, ¼ by 2 ⅛ by 15¼ in. Shape it with plane and pocket knife and smooth the surface with sandpaper. Make the fuselage from a block 1 in. by 1¾ by 9 in., shape it with saw and knife, and cut a recess or seat to receive the wing, which is named on. Two seats should be cut in the rear end of the fuselage to hold the rubber units in place. The windows and hood lines are indicated with India ink and black paint. Cut the wheels from ¼-in. wood or use the wheels from a small toy.

The four main wing struts are uniform in size and cut from thin aluminum or other sheet metal as are also the remaining



Top, side, and front views of the model and details of the fuselage, rudder, stab ilizer, and landing gear. All important dimensions are marked, and any others may be quickly found by using the scale

strut members except the one marked *E* and the tail skid, which are 1/32-in. wire. All the sheet metal struts are attached with nails and also secured with rivets at certain points as shown on the drawings. Insert a wooden plug as shown in the vertical slot in the end of the fuselage so the tail skid can be attached.

Shock absorbers can be made of balsa wood by drilling a row of small holes and making a slot to take the strut, and then carving the wood to the shape and size given in the detail marked *F*. A still simpler way to make the shock absorbers is to use a piece of adhesive paper tape of

Four suggestions for mounting a model on a single heavy wire set into a weighted base

the kind used in wrapping packages. Cut a strip 2 in. long and taper it with a razor blade from a width of ⅛ in. at one end to ¼ in. at the other end. Stick the wide end to the strut and wrap on the entire strip, being careful to keep it centered. When painted, it will closely resemble a real shock absorber. This method also could be used on larger models.

Make the propeller of thin aluminum ¼ by 3 in. and give it a bright polish. An attractive color scheme for the model is as follows: Wing, vertical tail, and horizontal tail, yellow; fuselage, struts, and wheels, orange, tires and trim, black, propeller, aluminum.

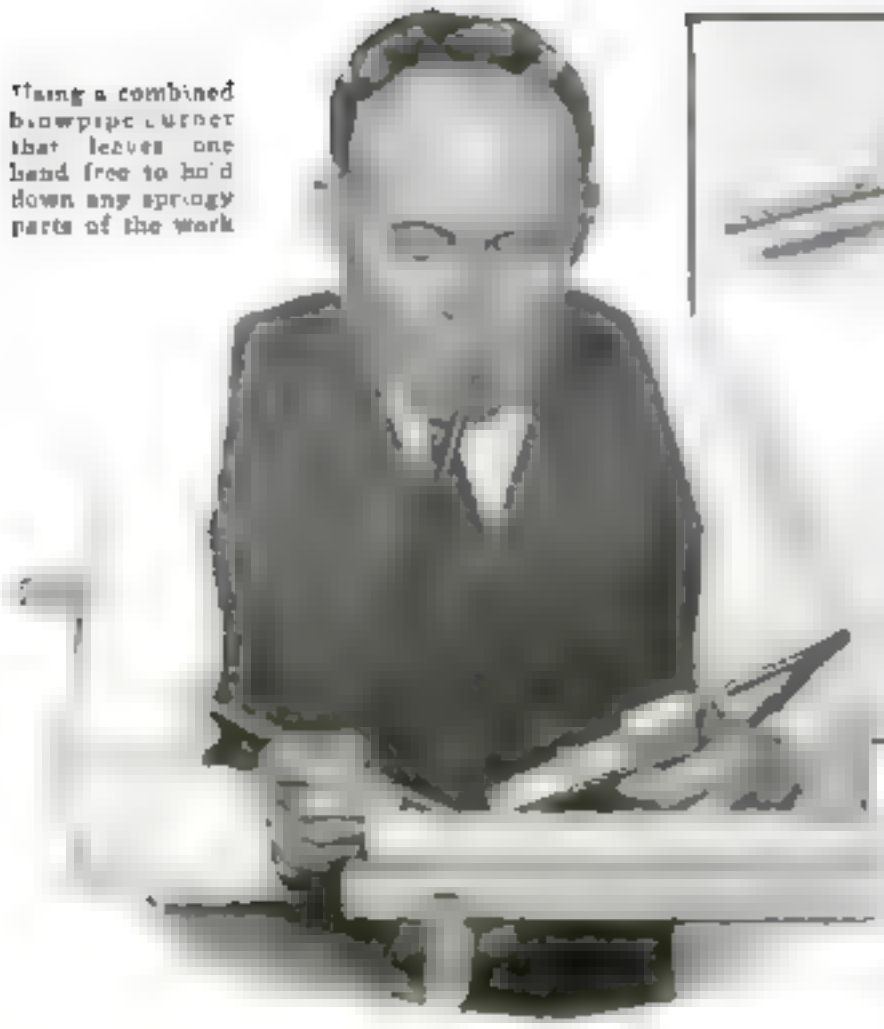
A novel way to mount this or any of the preceding nineteen models in this series is suggested in the four sketches above.

FORMULA MAKES HOUSE PLANTS GROW LARGE

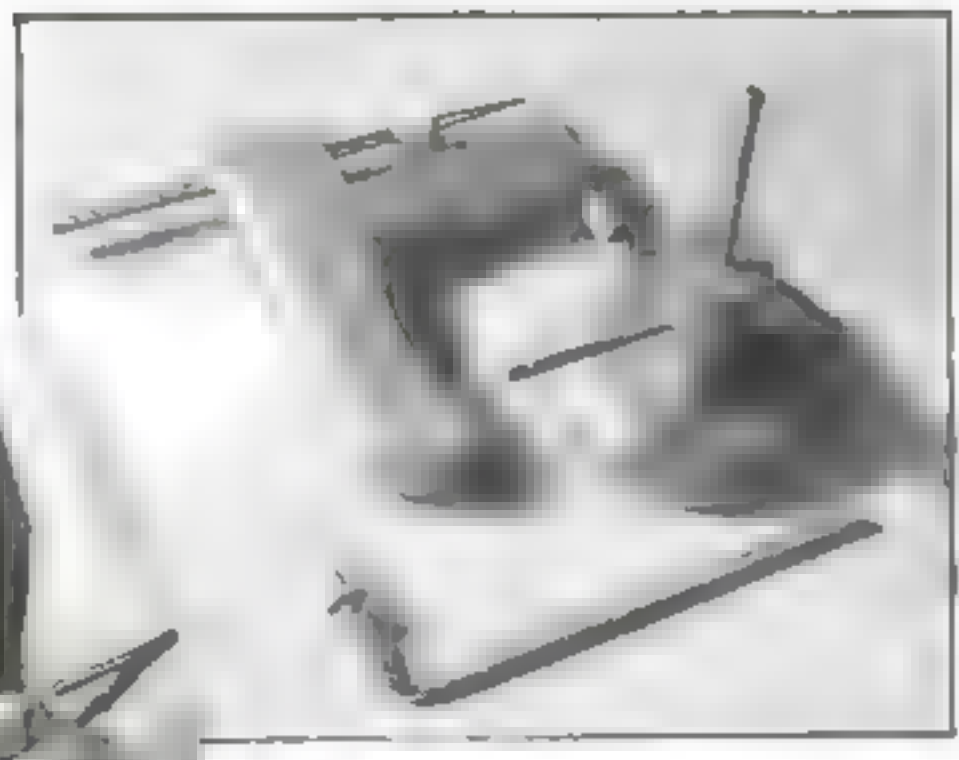
HERE is a formula for making house plants grow that will give surprising results. On one occasion, when it was used on a gloxinia plant, the leaves grew to the size of a saucer and there were twenty-six blooms. Prepare a mixture of 30 parts ammonium sulphate, 30 parts sodium chloride, 15 parts potassium nitrate, 15 parts magnesium sulphate, and 10 parts sodium phosphate. After the ingredients are properly mixed, add about 2 grams, or a good sized pinch, of the formula to 1 gallon of water. Use this solution to water your plants.—CLARK L. WADE

BORAX DELAYS SETTING OF PLASTER OF PARIS

PLASTER of Paris may be used for patching cracked casts and similar work without undue haste if powdered borax is added in the proportions of 2 oz. to 1 lb. of plaster. Mix the powders well in their dry state and then add cold water until the resultant paste is of the consistency desired. The plaster will take almost twice as long as usual to become set and unworkable. This is a formula often used by dentists and doctors.—JULES J. SIEKMAN



Using a combined blowpipe burner that leaves one hand free to hold down any springy parts of the work



By
EDWIN
M.
LOVE

Pistol-Grip Blowpipe SIMPLIFIES *Silver Soldering*

IN THE assembling of small parts, such as miniature coach railings and lamp brackets, silver soldering is much more satisfactory than soft soldering, since the joints are as strong as the metal itself. The ease with which such members may be shaped or altered after being hard soldered makes this method of joining almost indispensable to model makers. The small blowpipes needed for this type of work, however, are not always easy to obtain.

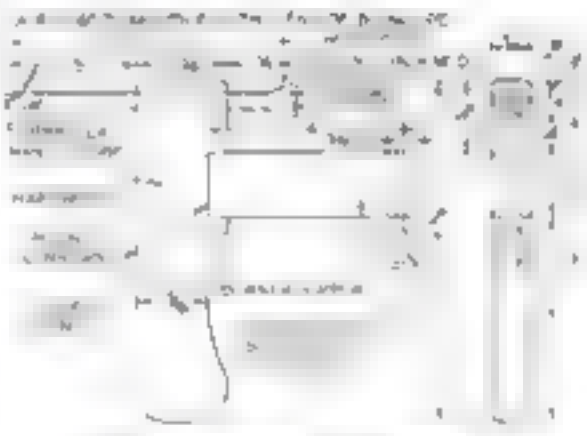
The writer found homemade apparatus built of shop odds and ends, entirely suitable for the task. For metal tubing, the handle of an old umbrella served; for blowpipe points or nozzles, small sewing machine oil-can spouts; and for the bases, hardwood.

For most work, a combination blowpipe and burner is most satisfactory, since one hand is left free to manipulate the parts being joined. A 5½-in. length of ⅝-in. metal tube is forced into the base of an oil can spout, and a cone of plastic composition wood is used to secure it. The handle is ⅞-in. wood 6⅝ in. long, shaped to a pistol grip and notched ⅜ in. deep in the front edge to receive the burner support. Both the handle and the 4 in. long burner support are drilled edgewise as shown for the tubes.

Drive the tubes into the holes, and glue the support into the handle. The tip of the blowpipe should be about ⅛ in. above the inner edge of the burner. Stop any openings with glue or composition wood.

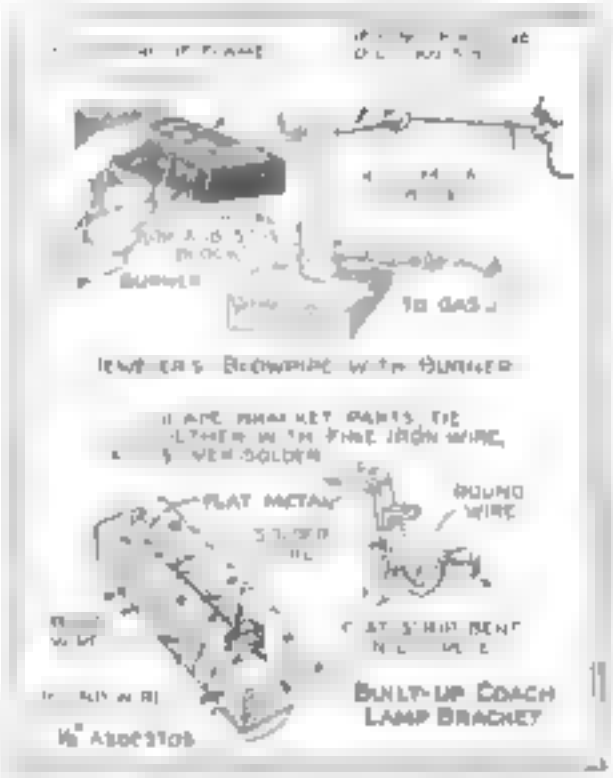
For very small, simple work, a separate burner and pipe are sufficient. The blowpipe is simply a tube bent at right angles to itself near one end, and fitted with a spout. The construction of the burner is self-evident. The upright support is bored down the center and then in from the side so the gas pipes will form a right angle. The gas hose is attached to the horizontal tube. No air inlet is needed, since the blowpipe supplies the oxygen.

Silver solder comes in various forms,



How the combination blowpipe may be made up of odds and ends. Its finished appearance is shown in the photo at the top of the page

Much small work may be silver soldered with a gas burner and an ordinary blowpipe similar to that used by jewelers



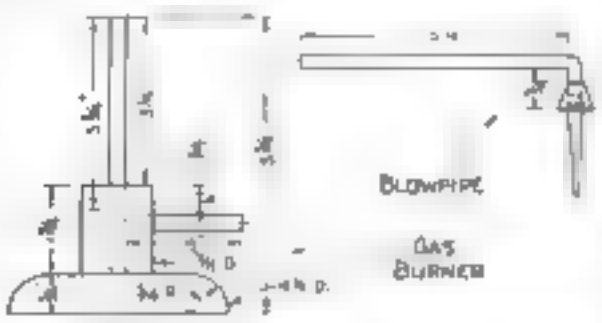
Soldering with a separate burner and mouth blowpipe. How model parts are bound together

my preference is for a thin, narrow roll. Sandpaper both sides of one end, and snip it into a fine fringe. Cut thin strips off crosswise to make small bits 1/32 in. square or smaller. Let them fall on a piece of glass where they can be seen.

Clean the parts to be soldered, tie them to an asbestos covered strip of wood, and moisten the joints with borax dissolved in water, applying the solution with a small brush. Ordinary flux will not do because it evaporates at too low a temperature. If the pistol-grip blowpipe is to be used, connect the burner with the gas and slip the rubber mouth tube on the pipe. Light the gas and adjust the flame to a 2-in. height.

With the brush, pick up two or three bits of solder and carefully lay them on

the joint. Blowing in the tube, gently play the flame over the joint until the flux is dry; then blow hard enough to heat the joint to redness. Do not, however,



Drawings with suggested dimensions for making a plain burner and a jeweler's blowpipe

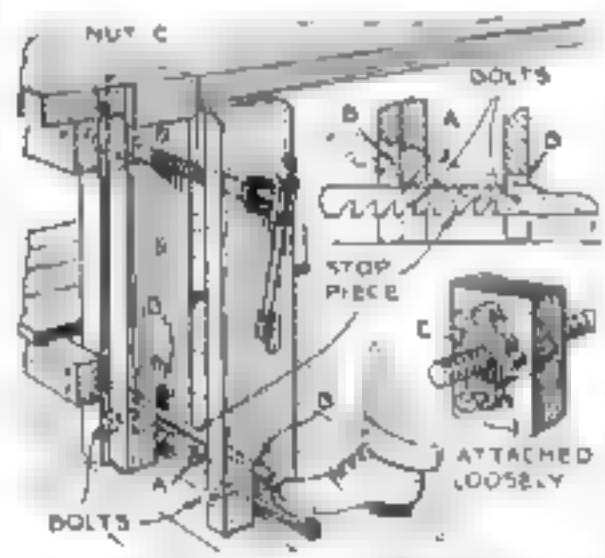
point the flame directly at the solder; endeavor to heat the metal alongside. When the solder flows, the joint is done.

To maintain an even blast, puff out the cheeks, expelling the air from them while a breath is being taken. If necessary, flatten the tip with pliers to reduce the outlet, so the pressure can be "backed up."

The simpler type of blowpipe is used as shown at the bottom of page 96.

ADJUSTING THE BOTTOM OF A WOODEN VISE

TO ADJUST the bottom of an ordinary homemade woodworking vise for work of various thicknesses, it is almost invariably necessary to stoop down and move a peg from one hole to another in a strip of wood, the peg acting as a stop. A more convenient method is illustrated. The strip of hardwood which serves as the stop piece is notched as shown at *A*, and slots are cut in the bottom of each of the long jaws to receive it, as at *B*. It is pivoted



A foot-operated stop for an using the bottom of a bench vise with long wooden jaws

in the movable jaw by means of a bolt, and its notches engage a similar bolt in the stationary jaw. By pressing the projecting end of this piece with the foot, it can be raised sufficiently to allow the vise to be closed to any width desired.

Another slight improvement is to attach the vise nut C loosely in place and provide some kind of stop to keep it from turning with the vise screw. This gives added flexibility.—H. T

GASKET shellac, if applied to either wood screws or machine screws, makes them slightly easier to drive and when dry, cements them firmly in place.—G. H.

Boxes Covered *with* Leather

make ATTRACTIVE GIFTS *of universal appeal*

By F. Clarke Hughes

RICHLY ornamented and costly looking leather covered boxes can be made at comparatively small cost and used as gifts to present to either men or women. The one illustrated was designed as a preference chest for several brands of cigarettes, but the same method of construction will serve in making small boxes for any purpose

In the majority of cases it is possible to use high-grade cigar boxes, candy boxes, or other containers instead of constructing the body of the box itself If, however the box is specially made, it should be either cedar or one of the better hardwoods.

Measure the lid and the body separately for the size of the leather. This may be any of the cheaper varieties such as sheep- or goatskin, although if much tooling or any deep tooling is to be done on the sides and the top, it is suggested that regular tooling calf or some of the better stocks be used. The improvement in appearance will more than justify the small difference in the cost

For the lid, the leather must be large enough to cover the actual surface of the top and the sides and ends plus enough to wrap around the edges—in the example given, 5½ by 11 in. The leather for the sides should be long enough to reach completely around the box and wide enough to lap over and cover the upper edge of the body and extend under the bottom about ½ in —in this case 3 by 24 in. The joint should be at the back, and the ends skived or shaved thin so the lap will be inconspicuous. In fact, all the edges require to be skived down to a featheredge. Care must be taken that the knife does not cut too deeply and ruin the leather

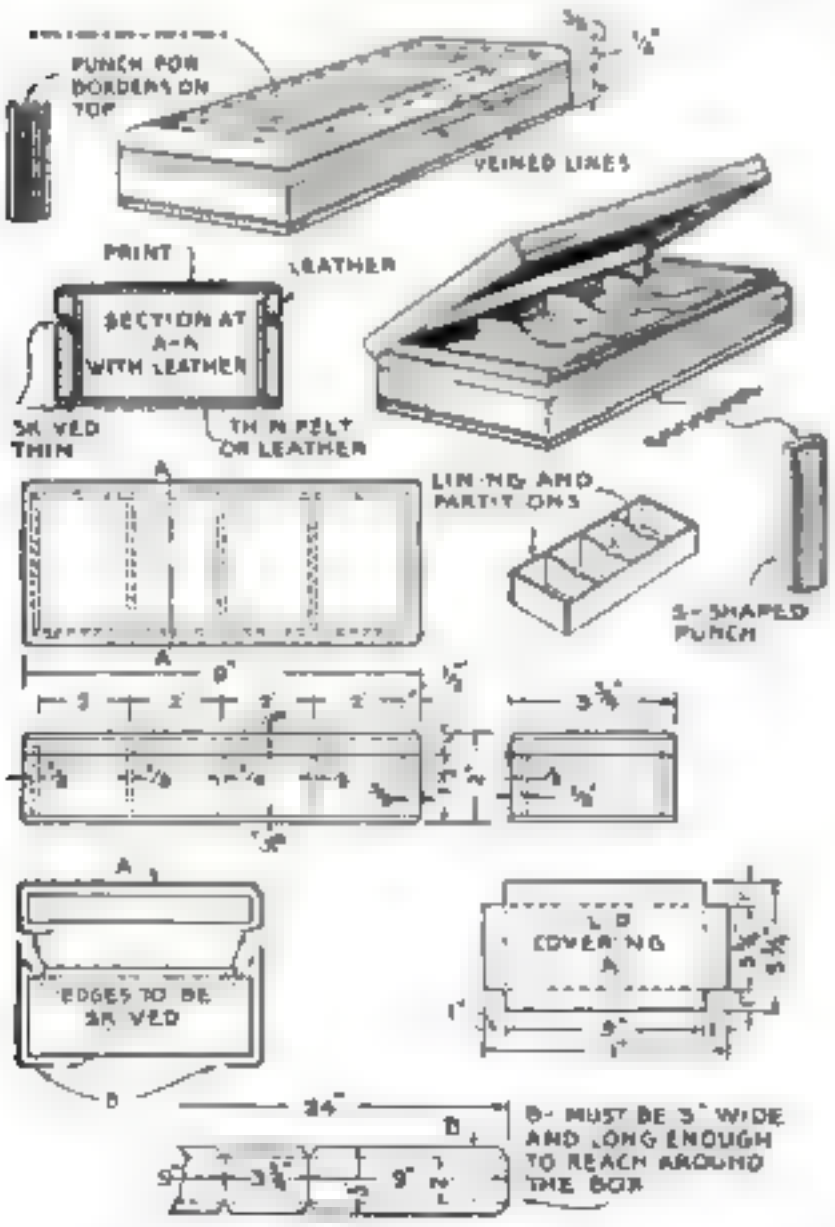
The fitting and mitering of the corners requires painstaking work. The beginner may well leave most of this close fitting until the leather is partly glued in place, then he can cut the parts as needed Regular leather cement should be used for best results, but glue sold for household purposes will serve, although it may eventually break down and allow the leather to peel away from the wood. If either glue or cement is applied too thick, the moisture may penetrate the leather and cause an unsightly stain The bottom of the box may be covered with thin leather or felt, or merely stained or painted

The main part of the decorative scheme should be a colored print mounted in the center of the lid with tooled and stamped lines to form a frame or border. The illustration may be of any subject, but the colors should harmonize well with the general tone of the leather. Many art shops sell bright colored English coaching and hunting scenes which are appropriate. If the print is varnished with white shellac or clear lacquer after the cement or glue is dry, it will be as durable and lasting as the box itself

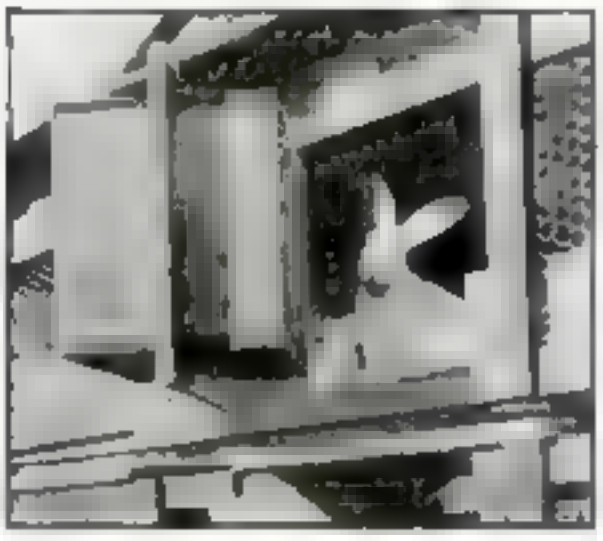
The border designs are easily made if the surface of the leather is first moistened with a brush dipped in water Even one of the cheaper grades of leather can be tooled or stamped without difficulty. For the border used on the sides and ends of the box, a special S-shaped punch may be filed from any odd piece of iron or soft steel. This punch, however, should be only about 3/16 in. in width. Hit the punch lightly with a hammer or mallet—just hard enough to make an impression. The broken line on the lid requires another punch made and applied in a similar manner. The tooled lines are produced with a tooling awl as described in previous articles in this series.

If it is desired to tone the lines, any of the methods suggested in former articles may be used, but preferably genuine gilding (see P.S.M., Feb. '31, p. 94). A sort of gilded effect can be obtained by mixing gold powder with linseed oil and thinning with benzine, just as when the toning is done with oil colors. After this mixture has been applied, the surface may be wiped clean, leaving the veined lines gold colored

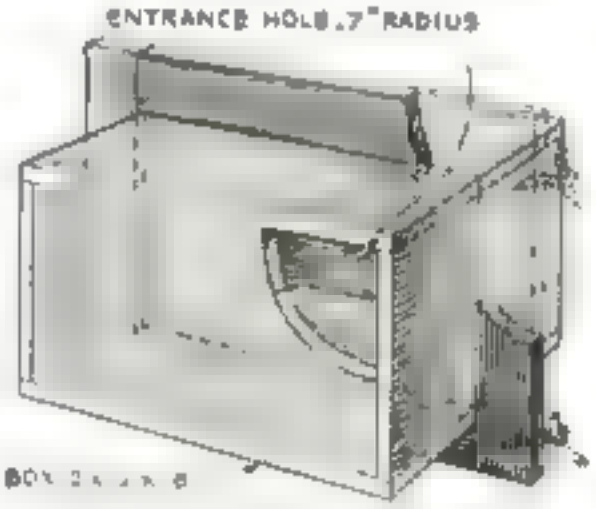
When all the finishing is done, the hinges should be put on and the leather given the usual waxing and polishing.



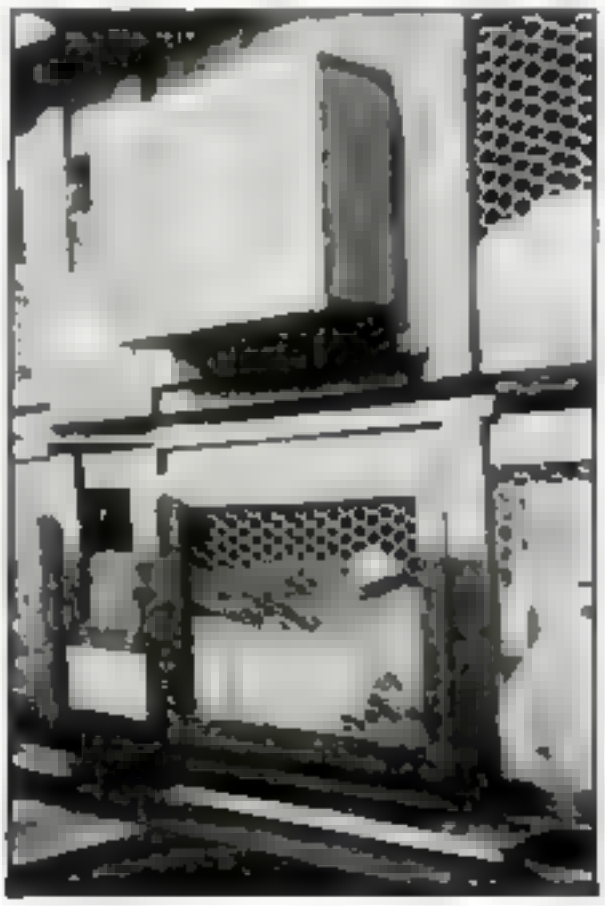
Rabbit Nesting Box Fits Hutch Door



BY PLACING the nesting box in the doorway of a rabbit hutch as illustrated half inside and half outside it is possible to save considerable space. In fact a 24-in. hutch with this arrangement gives the doe as much room as a 30-in. hutch with a nest box inside. The box is set in a frame of the same size as the regular hutch door, and the entrance is cut in one of the upper corners. When the nest is no longer needed, it is lifted off and the door replaced.—LAURA E. LYONS.



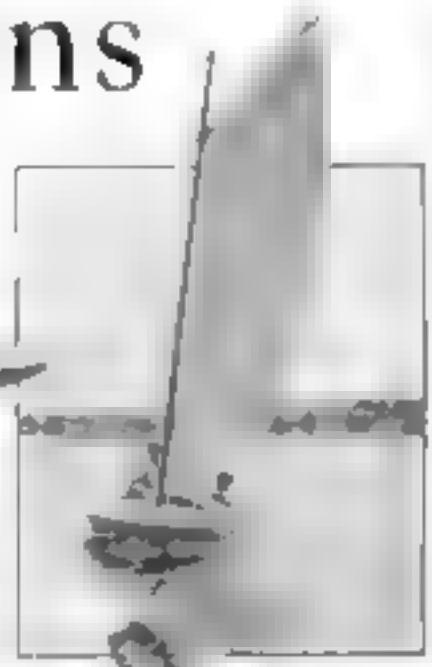
FRAME SAME SIZE AS HUTCH DOOR



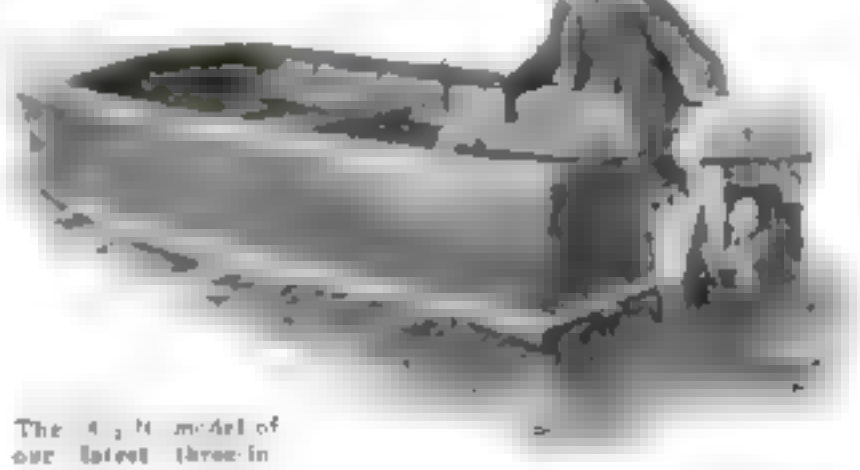
This nest box, which is hung in place like a door, saves space and is easy to examine

In the lead and gaining fast! That's a real thrill—and many Popular Science Monthly readers have enjoyed it after building our 11½-ft. outboard racing boat

Readers Have Great Success with our Boat Plans



Above is another of the outboard racers. It was built by E. P. M. Capps. At the right is a sailboat motorboat made by 16-year-old Minot A. Edson



The 4-in-1 model of our latest three-in-one combination boat

WHAT remarkable success readers have had building the various POPULAR SCIENCE MONTHLY boats has been reflected in the many enthusiastic letters they have written. Comments received from a few of those who have constructed our outboard racer from Blueprints Nos. 128 and 129 (see page 110) are as follows

Your plans are the best that I ever had for a home builder of boats. The outboard racer handles wonderfully. It is the best boat I have ever owned and driven. . . . I find the boat the fastest looking and the best running I have ever seen. Have already raced boats with twice as much horsepower as I use and I have beat them. I sold the boat for a good profit and am building another. The boat develops remarkable speed and is exceptionally seaworthy. I tried to upset the outfit but did not succeed!

A page could be filled with similar extracts. Because of the popularity of this boat, we have made arrangements for William Jackson, the designer, to prepare full size patterns from his own master templates. These can be obtained from our Blueprint Department for $1.50 a set, or $2.00 for both blueprints and patterns.

Full size patterns are also ready at $1.50 a set for the 15-ft. combination sailboat-motorboat of Blueprints Nos. 131, 132, and 133. This is another boat which has won wide approval from readers, as this letter indicates

A very fine boat. Made great speed. I included air floats for safety. Built it with one helper and only in my spare time in a period covering thirty-two days. To try out safety, I took seven men out on Lake Erie in rough sea and never shipped a spoonful of water

The latest in our series of boats is the three-in-one combination hull. It can be made 13 ft. long (Blueprint No. 147), 14½ ft. long (No. 148), and 16 ft. long (No. 149), and used with oars, with an outboard motor, or with one of the new stern drive arrangements installed as shown in Blueprint No. 150. Full size patterns for all three are available at $1.50 a set, or $1.75 with the blueprint.

OUTDOOR Fireplace AND *Incinerator*

At the left the outdoor fireplace is arranged with an open top for cooking, at the right, with a closed top for incinerating

THE outdoor fireplace illustrated above is in everyday use as an incinerator, but it also serves on special occasions for cooking. In the city in California where it is set up, there is a good deal of cooking and eating outdoors in the summer time, and the custom is becoming more popular in other parts of the country.

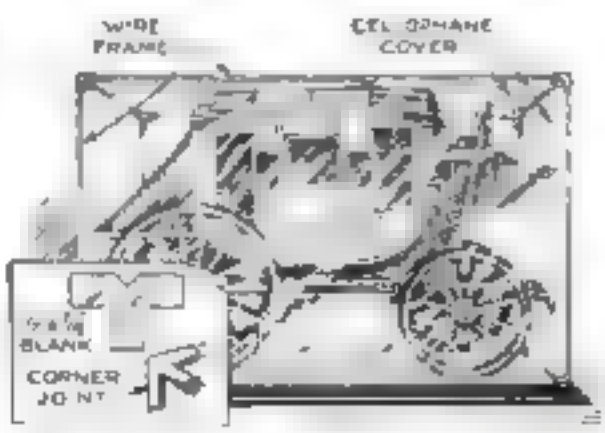
The principal materials used in constructing it were 200 common bricks, a few decorative tiles, one piece of concrete sewer pipe, an old floor register (for the grating), ¾-in. pipe for grate bars, a piece of heavy sheet metal for the cover, and some old iron for reënforcement.

For incinerating purposes it has a solid top counterweighted so that it may easily be raised to insert the rubbish to be burned. The grate bars are at the level of the wall offset. The ash pit is wide enough to allow a shovel to be inserted.

When the fireplace is used for cooking, the grating is substituted for the solid top, and an additional set of grate bars are dropped on lugs 8 in. down from the top to bring the coals close enough for broiling steaks, chops, frankfurters, or whatever is to be "barbecued." The draft through the stack is then checked so that the heat is all on top of the stove. Holes in front, regulated by inserting bricks as plugs, admit air when necessary over the lower grate bars. Two of these plugs can be seen in the photograph at the right above.—H. C.

PROTECTING DELICATE MODELS FROM DUST

For protecting a stagecoach or ship model from dust and the wear and tear of constant cleaning, a frame may be made of heavy galvanized wire or thin welding rods and covered with the cellophane type of tough, transparent wrapping material used for cigarettes, candy boxes, and many other purposes. Such a cover looks well and allows the model to be seen quite clearly, and it may be removed easily on state occasions or when the model is to be placed on special exhibition.



Concord stagecoach model in a case made by covering a wire framework with cellophane

Radio bus wire is about the right size for the frame, but it is soft and will sag unless the model is a very small one. The joints are fastened with eight pieces of tin ½ by ¾ in., shaped as shown. The pieces are bent around a finishing nail to form sockets for the wire ends. Bend the top sockets of each piece at right angles, insert the wire ends, and solder. The cellophane should be cut to overlap about ¼ in. at the corners. Use a colorless, quick drying household cement to fasten the laps.—W. L. Fawcett

Thread Guide *Makes It Easy to* Rewrap Fishing Rods

ANGLERS who take pride in keeping their fishing tackle in repair will see at once the advantages of this rack, which makes it possible to wrap fishing rods with machinelike precision and uniformity.

The frame of the rack is constructed of two pieces of wood about 1 by 2 by 12 in. and two pieces 1 by 2 by 8 in. A dowel rod or other round stick small enough to pass through the spools of wrapping silk is also required, as are two or three rubber bands, wire for making a hook, and a few nails.

Holes are drilled through the frame to receive the round stick. The spools are slipped on this spindle and kept from turning by wedging them in place with small splinters of wood. To prevent the spindle from revolving too freely, a wire hook is bent to fit over one of the projecting ends, and several rubber bands are run from the hook to a nail in the back part of the frame. The tension is regulated by adding or removing rubber bands. Fine saw cuts are made in the front crosspiece as shown to guide the threads, and two notches are cut in the front ends of the sidepieces to receive the fishing rod.

...k may be clamped in a vise or ... the edge of a table or work- ... that the rod has been cleaned ...sh and old wrappings, and be ...ands are perfectly clean before ...either the rod or the thread.

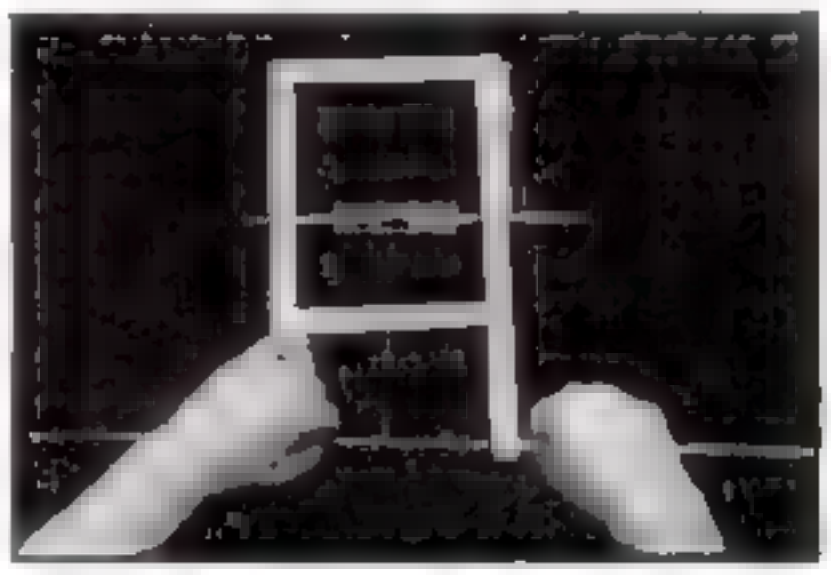
When removing the old wrappings, notice how they were put on so you can duplicate the method.

Always turn the rod upward and toward you when wrapping, this will enable you to see just where the thread is going. Use all the tension you can, and the silk will go on evenly and closely.

Two or three coats of spar varnish over each wrapping and one or two over the whole rod will be sufficient. Too much varnish is objectionable because it destroys the fine action of the rod.

One precaution should be added. Choose silk thread that is several shades lighter than you desire it to be when varnished, as the varnish will darken it. Do not use collodion, celluloid, or other preparations in an effort to avoid this darkening effect. Varnish is better because it penetrates to the wood and holds the wrappings securely.

If you take sufficient care in applying the finish you will find that no one can tell that the repairs were not made by a professional.—W. C. Watt.



How the thread guide is used. The fishing rod, placed in notches in the two sidepiece ends, is revolved toward you

MAKING A NOISY SCROLL SAW RUN SMOOTHLY

CERTAIN types of scroll saws, especially homemade ones, vibrate unpleasantly because the arms are not properly balanced. If in such cases, the frame is counterweighted as shown, the saw will run with greater smoothness, even when the bearings are in poor condition. A short rod is bolted to the upper saw arm so that it projects to the rear, and a sliding counterweight is secured to it with a set screw. The counterweight should be adjusted by shifting it back and forth until it brings the saw frame into perfect balance and compensates for the large overhang.—C. F. Blake.

A counterweighted frame lessens vibration

Fine Furniture ANYONE CAN ASSEMBLE

KIT NO. 4

KIT NO. 2

Both the [illegible] and the small tray-top table (shown above at the right) are of carefully chosen mahogany

KIT NO. 1

The Colonial butterfly table at the left and the larger coffee table at the right are made of maple. The coffee table can also be had in mahogany. All four pieces correspond in quality to the finest custom-built furniture

KIT NO. 3

IF YOU have never experienced the intense feeling of satisfaction and achievement that comes from building a beautiful piece of furniture with your own hands, you can enjoy it now by sending for one of the new Popular Science Homecraft Guild kits.

Each kit contains all the necessary materials and is accompanied by illustrated instructions. The wooden parts are machined to fit together so perfectly that no experience in woodworking is necessary, and the tools which are to be found in almost any household tool box are sufficient for the work

By assembling these kits, the beginner can learn more about how to construct furniture than he could discover from a long and tiresome study of woodworking handbooks. What is more, he will see how easy it is to build fine furniture and be encouraged to add to his tools and shop equipment so that he can undertake projects of his own

Kit No. 1 is a maple butterfly table of Colonial design with an oval top 17 by 22 in., and 22½ in. high. Kit No. 2 is a solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Kit No. 3 is a tilt-top coffee table 21 in. high, the top being 19 by 28 in. It can be had in either maple or mahogany. Kit No. 4 is a solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¼ in. high over all. A coupon is given for your convenience in ordering, but if you prefer not to cut the magazine, you may order by writing a separate letter

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me the following kit or kits for which I enclose $
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Milling Tools

FOR THE HOME MACHINIST'S LATHE

By HOLT LONDON

THE milling attachments illustrated were designed and made by the writer in his home workshop to adapt a 9-in. lathe for the milling operations which are so often required to bring light machine work to completion. Forming square or hexagonal heads on screws and machining flats, keyways, or flutes on turned work are examples of the work that can be done with these accessories.

The tools necessary for such work may be divided into two groups: those required to fix multiple tooth milling cutters to the lathe spindle and those fixtures needed for holding the work and feeding it under control to the cutters. The second type will be described in a later article.

To mount plain milling cutters on an arbor of the conventional milling machine type—that is, set into the taper of the lathe spindle and supported at its outer end with the tail center—would allow, in this case, very little working space under the cutter. The lathe is limited too, in its capacity to absorb safely the strains set up in slabbing cuts or those in which the work is fed under and against plain milling cutters for the production of plane surfaces. In lathe milling it is generally possible and preferable to use the many variations of end mills, the work being fed across the end of the cutters in successive light cuts.

For very small work like splined keyways, the cutters may be made simply by grinding the stubs of old drills into a two-lipped or "fishtail" form. A drill chuck or, even better, a draw-in collet is used to mount them.

Large cutters, however, must be bought. A 7/16-in. end mill of right-hand cut and left-hand spiral is illustrated, together with its homemade sleeve, which is turned to fit the Morse taper of the lathe spindle and bored to receive the B. & S. taper No. 4 of the milling cutter.

This bore was produced by setting the

Tightening the bolts that fasten the stub arbor to the faceplate. The arbor can be used for holding not only the steel end mill shown in place but also plain cutters and slitting saws

sleeve blank into the lathe spindle and using the compound slide to feed the boring tool by hand. The required setting for this operation was found by placing the end mill to be fitted between centers after its shank had been copper coated. With a tool bit set level with the centers, the compound rest was adjusted angularly so that a line could be traced along the cutter shank. A boring tool set at the proper level then yielded a taper bore which needed only to be sized to fit the shank. The copper sulphate film again served to prove this final fit

FOR still larger and more general work, a stub arbor was designed to accommodate either shell end mills as shown in the set-up at the bottom of page 104 or, when fitted with its adapter sleeve to mount plain cutters and slitting saws. A 60-deg. countersink in the end of the tool serves in connection with the tail center to give additional support whenever the dimensions of the work permit

When used to drive cutters of this kind, the driving collar, the lugs of which engage the slots in the end mill, is run off the threaded shoulder of the arbor and the flatted sleeve with its spacing collar and nut replaces it. This brings the arbor diameter up to 1 in., which is a standard for cutters of this type and size

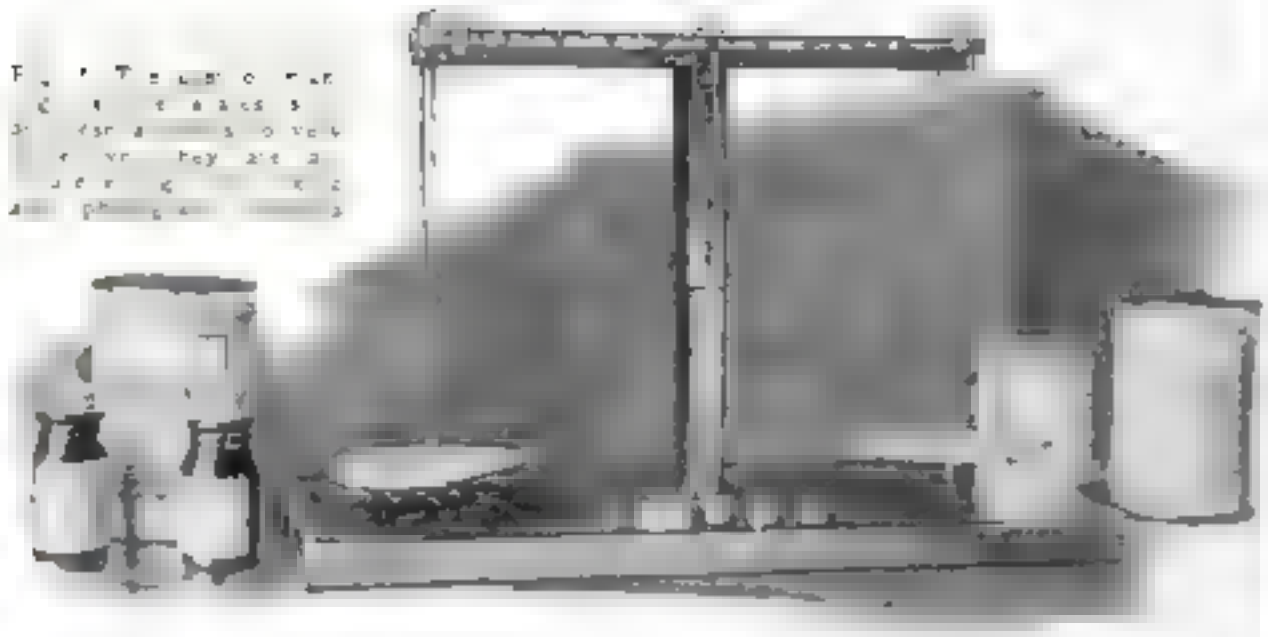
It will be noted that the flange of this arbor was faced to a boss or projection which seats in a 3/32-in. counterbore in the faceplate. This meant altering only the chamfer of the plate and in no way impaired its usefulness. This device quickly and accurately centers the tool for attachment. The 7/16-in. screws which strap it back to the plate are run through into nuts milled to key into the faceplate slots, therefore the use of but one wrench is required. The arbor becomes in this way a rigid extension of the lathe spindle with no possible damage to the spindle taper bore, the perfect condition of which is so vital to accurate turning. The arbor still bears the earmarks of the automobile crankshaft from which it was made It rings like a bell, yet needed no annealing to make it workable

IN DEVELOPING these tools, the writer had in mind the home shop with no other machine tool than a small lathe His idea was first of all to protect his lathe from abuse. The fixtures for holding work to be milled present a real problem in that the stresses of milling are often produced in a direction and to a degree quite different from those for which the lathe was designed. For one lacking experience in milling practice, this work should be approached with a good deal of caution and not without considerable reading along this line.

An article by Mr Condon on making fixtures to hold work that is to be milled in the lathe will appear in an early issue

KEEPING PUTTY SOFT

LEFT-OVER putty can be kept soft by placing it in an old salad dressing jar pouring a very little linseed oil on top and screwing on the cover tightly, with the wax paper insert still in place to make an air-tight seal.—GEORGE V BAKER.



An Inexpensive Balance *for weighing* PHOTOGRAPHIC CHEMICALS

By DANA S. GREENLAW

IF YOU do photographic developing and printing, you will save money by mixing your own developing and fixing solutions. Of course, scales are necessary to weigh the different amounts of chemicals required for each formula. Extreme accuracy is not required; an error of two or three parts in a hundred will not affect results. However, an error of more than 5 percent often will cause trouble.

Scales sufficiently accurate for the purpose can be bought for from $3 to $6, or you can build one like that illustrated in Fig. 1 for a few pennies.

The base (Fig. 3) is a piece of pine or other wood ¾ by 6 by 14 in. The upright, which is ⅝ by 1¼ by 8 in., is fastened to the base with a wood screw and a small angle. It is essential that the upright be absolutely square with the base.

A brass strip ⅛ in. wide and about 5 in. long is fastened to each edge of the upright, and extends ¼ in. above it. The two strips are notched with 90-deg. V's for holding the balance-arm pivot.

The balance arm is shown in Fig. 2. It consists of two 4-in. brass strips 10 in. long, and a 5/16-in. strip 13½ in. long. A 90-deg. bend is made 1½ in. from each end of the narrow strip. The two wider pieces are placed 1 in. apart and are soldered to the narrow strip, which also serves as the slider arm for the sliding

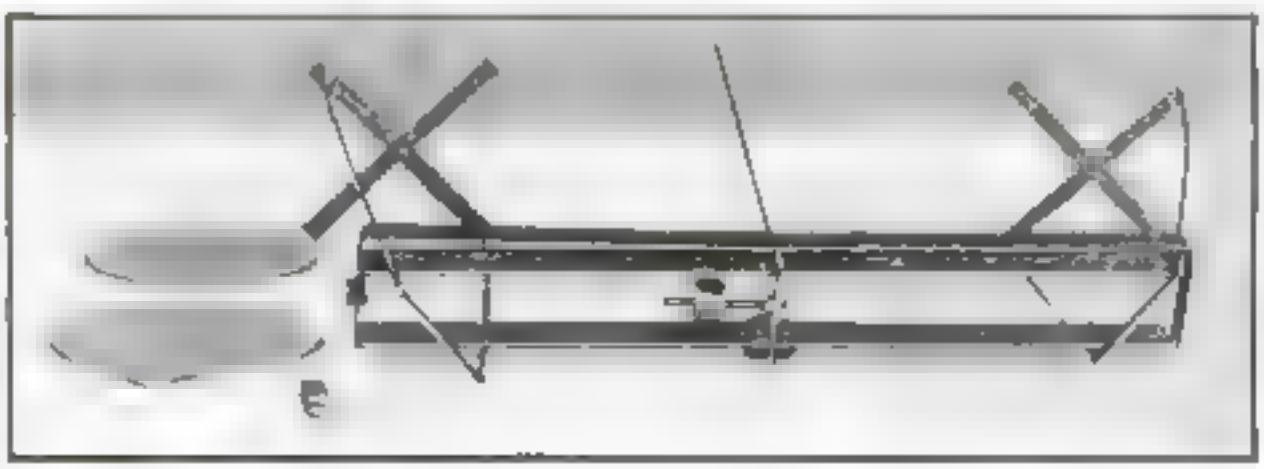


Fig. 2. This is practically a top view of the balance arm with pan holders and pointer. Note the counterweight attached to the center pivot. The pans and slider are shown at the left

brass weight shown at the left in Fig. 2.

The center pivot is shown in Fig. 4. It is ground from an old hack saw blade. A slot about ¼ in. deep is made in the center of the two ⅜-in. pieces of the balance arm for holding this pivot in place while soldering. The knife-edges of the pivot should be slightly below the top of the arm. A knitting needle is soldered at the pivotal point as an indicator (Fig. 2).

Small V-shaped nicks are made at each end of the ⅝-in. strips for holding the pan pivots in place. These nicks should be about 5 in. from the center pivot. The exact distance is not especially important, but it is absolutely necessary that the distance from the pivot to one notch be precisely the same as from the pivot to the other notch. The bottom of the nicks should be in line with the knife-edge of the center pivot

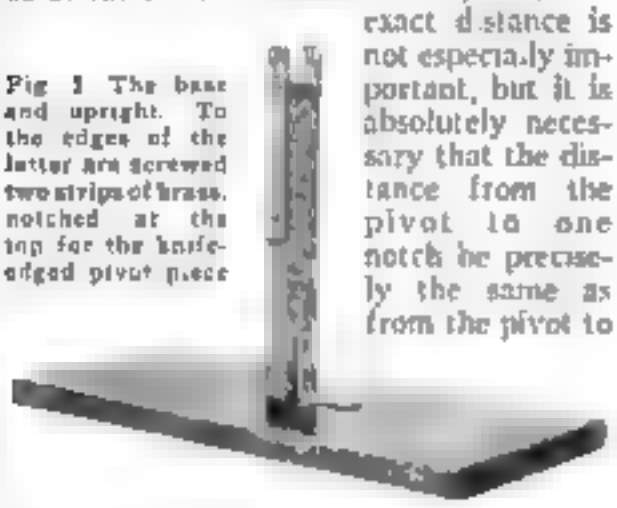


Fig. 1. The base and upright. To the edges of the latter are screwed two strips of brass, notched at the top for the knife-edged pivot piece

The pan-holder pivots are made by grinding a knife-edge on an old hack saw blade. They are ⅜ in. wide and 1⅛ in. long. The pan holders are made from two 5/16-in. pieces of brass 3½ in. long and are soldered together to form a cross. Two knitting needles or stiff pieces of wire are used to fasten each pan holder to the pivot piece, as shown. The pans, which are made from thin aluminum, should be trimmed to weigh exactly the same

A counterweight for adjusting the balance is made by soldering a brass screw 1½ in. long to the right side of the center pivot, and a lead weight about ⅜ in. in diameter and ⅜ in. long is tapped to fit the screw. The counterweight is shown clearly in Fig. 2

The system of weights may be either metric or English, as virtually all photographic formulas are given both ways. The metric system was used by the writer. The weights may be obtained from any photographic store. Do not purchase expensive weights, as such weights are made only for extremely sensitive balances, and their accuracy is not warranted for these scales. For the metric system, two 10-gram, one 20-gram, and one 50-gram weights will be needed. If a set can be borrowed, the weights can be made from pieces of brass

The slider is a ⅛ by ¼ by 3½ in. piece of brass with a slot in it. Place the slider at its zero position and turn the counterweight until it is about in the center of the screw. Then balance the scales by soldering a small piece of brass (if a few drops of solder are not sufficient) to the other end of the balance in an out-of-the-way place. Now move the sliding weight to the right end of the slider arm. It should then balance a 10-gram weight in the left-hand pan. If it does not, make the slider heavier by solder or lighter by filing, as required.

Mark the zero point and the 10-gram point on the slider arm. Divide the distance into 10 equal spaces, each representing a gram. Subdivide each space into 10 equal spaces for 1/10-gram divisions. The divisions are marked with a quick-drying enamel.

In weighing, be sure the scales are level. A level may be fastened to the base if desired. Always place the weights on the right-hand pan and put the chemicals on the left pan

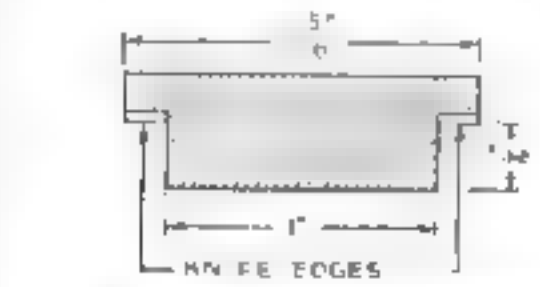
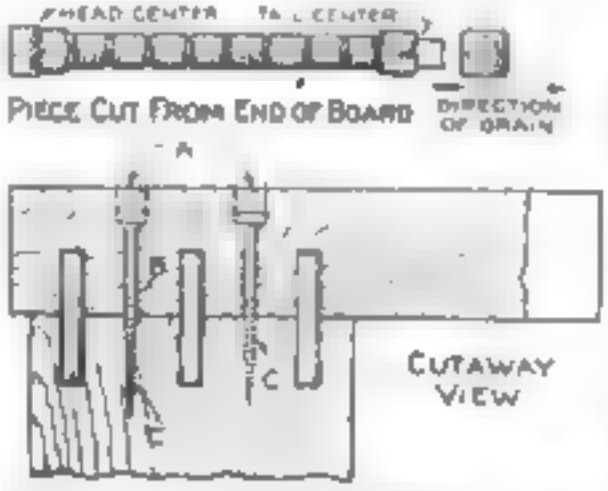


Fig. 4. How the central pivot piece of the balance arm is ground from a hack saw blade

STRENGTHENING DOWEL JOINTS WITH SCREWS

HOMEWORKERS often lack confidence in an ordinary dowel joint, especially if it is to be placed where the weather may affect it. In such cases it is desirable to reënforce the dowels with screws, if the design of the joint permits. Bore ⅛-in. holes at *A*; then drill shank holes *B* just large enough to allow the unthreaded part of the screw to slip through, and thread holes *C* no larger than the core of the thread and to a depth about ¼ in. less than the length of the screw. When driving the screws in the final assembly, drop a little thin glue in each hole *C* to make the screw hold better in the end grain, which does not give the threads as good a grip as face or edge grain.

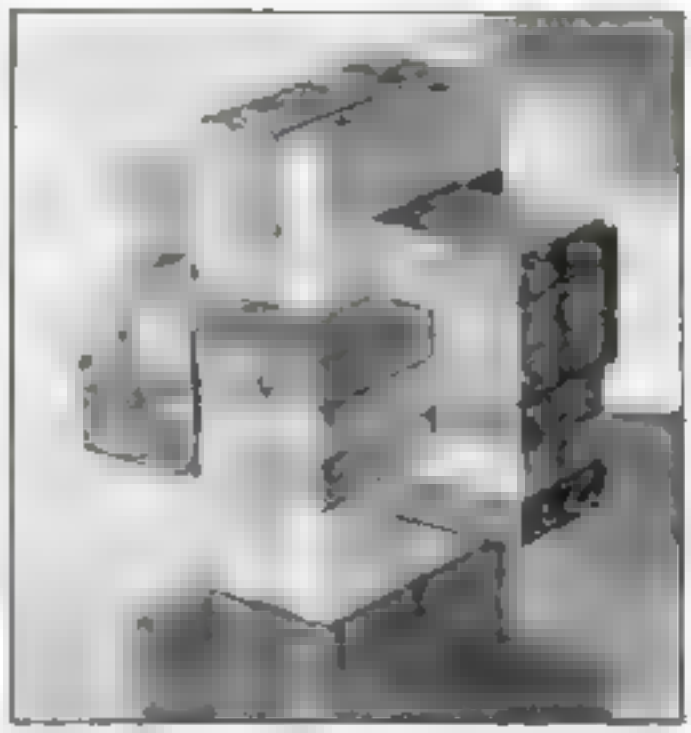


How screws may be used to reënforce a dowelled joint. *Above:* Method of turning plugs

After applying glue to the joint in the usual way, squeeze the parts together with clamps, if necessary, and drive the screws home. As they will then hold the joint, the clamp may be removed for other uses.

Turn ½-in. plugs from a piece of wood cut from the end of a ¾-in. board so that when they are glued in place over the screw heads, the grain will coincide with that of the surface in which they are inserted. Do not use an end-wood plug, for that is always the mark of a novice.

The same method of using screws may be applied in assembling certain types of furniture instead of driving unsightly roundhead screws.—D. W



How the puzzle looks when assembled. The blocks can all be cut from the same wood, or contrasting woods may be used

WOODWORKERS who like to fit small parts together will find an unusual challenge to their skill in this new puzzle devised especially for POPULAR SCIENCE MONTHLY readers by one of the leading authorities on verbal and mechanical brain teasers. Although made of eighteen pieces, the puzzle is assembled in the shape of an ordinary six-block Chinese cross. Those who wish to make simpler types of block puzzles will find a number of designs on Blueprint No. 65, obtainable for twenty-five cents.

ARTHUR L. SMITH devises a new form of *Chinese Cross* PUZZLE

THIS Chinese cross which contains eighteen pieces, is especially designed to be more difficult to take apart than the usual six-block puzzles such as those shown on POPULAR SCIENCE MONTHLY Blueprint No. 65 (see page 110)

The blocks are each ¼ by ¾ by 3½ in. Figure 1 shows the character of the cuts and their dimensions. They will all divide into the width and thickness of the blocks without a remainder, therefore they need not be described in detail.

Four blocks each of *A* and *D* are needed; 2 each of *C*, *E*, *F*; and 1 each of *B*, *G*, *H*, *I*. To put the cross together the block *F* is laid upon *H* (Fig. 2). Then a *D* block is fitted in the cut of *F*. Three *A* blocks are now placed and bound by another *D*. Figure 3 shows the assembly at this stage.

Next place in the order named: *F*, *E*, *D*, *C*, *E*, *D*, *C*, *G*, forming Fig. 4. The position of these eight blocks will be obvious from the character of the cuts. Turn this combination around to the position of Fig. 5 and insert the remaining blocks through the ¼ by ¾ in. hole, *A* and *B* first and *I* last. Blocks *B* and *I* have their longest ends inserted as shown by *I* in Fig. 5. Block *G* is now shoved up into place, serving as a lock.

Most persons find this puzzle, if accurately made, very difficult to get apart. Even if the only movable block *G* is discovered, it is hard to find which other block is released. The block *I* generally sticks somewhere and does not readily reveal the secret.

This form of the Chinese cross could be made still more intricate so that a number of blocks would have to be moved partially before the key block could be released.

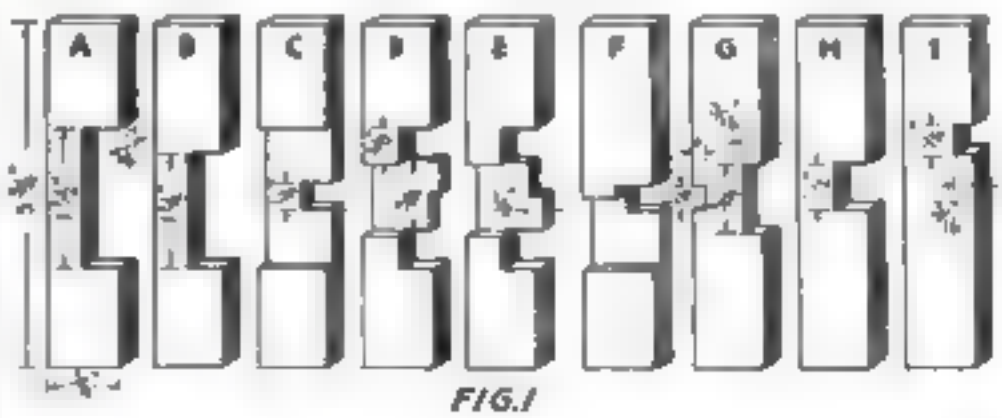


FIG. 1

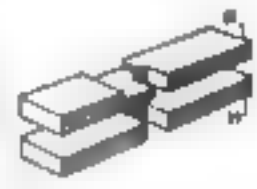


FIG. 2

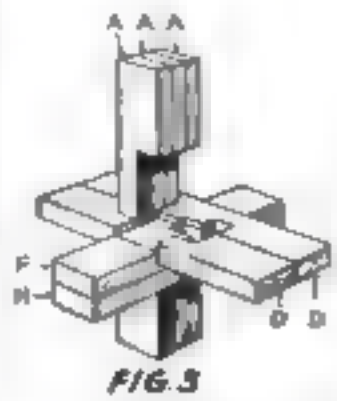


FIG. 3

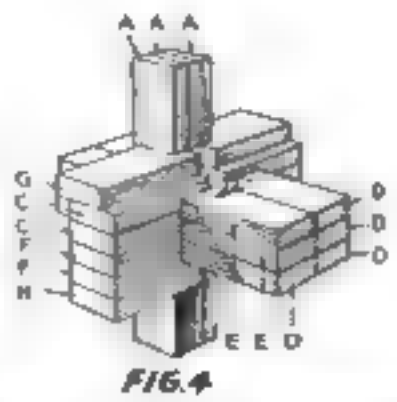


FIG. 4

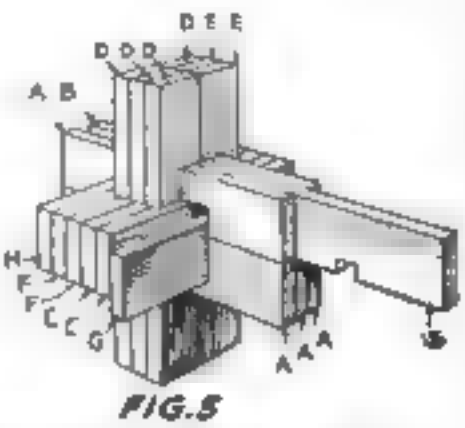


FIG. 5

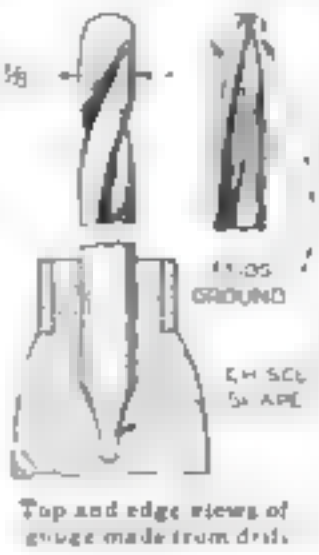
The blocks are made as shown in Fig. 1, four being required of *A* and *D*, two each of *C*, *E*, and *F*, and one each of the others. They are assembled by the method given in Figs. 2 to 5

A definite program for getting ahead financially will be found on page four of this issue

SMALL CARVING GOUGES MADE FROM DRILLS

TWO small gouges I have found useful for wood carving were made from old straight-shank drills, one ⅛ in. in diameter and the other smaller. These were ground as shown. Half the length of each tool was inserted in a handle, after a hole had been bored with the drill itself. The entering end was ground to a chisel shape to keep it from turning in the handle.

A good way to sharpen the concave side of these or any other small gouges is with a strip of hard wood which has been shaped to the right curvature and rubbed in any fine abrasive. If nothing better is at hand, the dust that comes from a grinding wheel can be used.—A. T. REYNOLDS.



Top and edge views of gouge made from drill

HOW TO OBTAIN OUR NEW KIT FOR BUILDING THE *WANDERER*

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These materials together with four blueprints which show all parts of the model full size and are alone worth $1.00 will be sent to any reader in the United States for $6.90. If you intend to build this beautiful new model, do not fail to take advantage of this special time- and money-saving offer.

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to Help You in Your Home Workshop

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ROCK GARDEN FISHPOOL

(Continued from page 87)

entire pool in order to clean and flush it.

The pool itself should be built with sloping sides. If the dirt removed is piled on either side of the excavation, the mounds may be used as part of the garden setting.

When the hole has been dug to the proper depth and the necessary allowance has been made for the thickness of the cement wall, the loose ground should be stamped down and packed hard to provide a substantial foundation for the concrete lining. Common hay wire, cut into lengths of about 6 in. and bent at right angles toward one end, are next inserted 3 or 4 in. apart throughout the inside of the hole to provide reinforcement for the cement.

One part of cement is mixed with 4 or 5 parts of coarse sand and gravel and sufficient water is added to make a rather stiff concrete. This is applied in small quantities with a gloved hand and patted against the inside wall to form a 2½- or 3-in. shell. A 3 in. high retaining wall built above the outer rim of the pool will prevent dirt and water from running into the enclosure.

After the cement has been applied to the inside of the pool, water is whisked about to prevent too rapid drying of the surface. It is then advisable to cover the concrete until it becomes thoroughly hard, in order to prevent too rapid drying out under a hot sun. Earth, straw, burlap, or any available material may be used.

Before any fish are placed in the water, the pool should be filled, emptied, and washed out three or four times with the garden hose to remove traces of lime. Washed sand may be spread over the bottom of the pool, and picturesque stones and shells placed both inside the pool and around the outside.

WORKSHOP CABINETS

(Continued from page 81)

treated in Fig. 1 (third from the top).

The tall, narrow drawer case at the right of Fig. 7 is fitted with drawers made from tin cigarette boxes which contained either 50 or 100 cigarettes. Remove the top and wire pin, and hammer down the hinge projections. The hinge pins may be bent to form handles, or heavier copper wire may be used. These handles are soldered into holes punched for them in the drawer ends, and small label holders are soldered just above them (*K*, Fig. 5). The sides of the drawer case are grooved for the narrow shelves either with a back saw and small chisel or with a plane head (Fig. 4), if available. Various methods of making wooden cases are illustrated at *L-O*, Fig. 5.

The very small drawer case which may be seen resting on top of the big one in the center of Fig. 7 is made of tin. The bottom section is a cigarette box; the sides, back, and drawer shelves are made from the tops of cigarette boxes. The case is shown in Fig. 6, but it is actually assembled upside down as illustrated in Fig. 4. The corners of the box tops used as shelves are cut out at an angle of about 45 deg. so that the projecting edges may be flattened down, and the hinge tubes are cut off all the toys.

In starting the assembly, a box cover is placed on the bench with the projecting edges or rim upward. The two sidepieces are clamped to it with small C-clamps or spring clothespins, and then soldered. Next a drawer is placed in position and a length of cardboard about 1 16 in. thick is set on the drawer as a spacer. The drawer shelf above it is put in place, held with clamps, and soldered. This continues until the required shelves have been placed, when a box is soldered in to form a base for the case. A box lid is also used for the back.

A definite program for getting ahead financially will be found on page four of this issue

FOR GOOD PHOTOS YOU NEED A GOOD LENS

(Continued from page 78)

the "speed" of the lens. Referring again to the diagram of Fig. 3, it is obvious that the larger the opening, the greater will be the cone of light collected by the lens and the brighter will be the corresponding point at the film surface. It takes a definite amount of light to affect the film, and the larger lens producing the brighter image has more "speed" because it makes possible a shorter exposure.

The size of the maximum stop or opening through the lens is known as the "F" number and always bears a definite relation to the distance the lens must be placed from the film to get objects a long distance away in sharp focus. An F 8 lens that focuses distant objects when it is 2 in. away from the film would have a maximum opening or stop of 1 in., a 16-in. lens of the same rating would have a maximum stop of 2 in., and so on. The biggest opening always is the focal length rating divided by the F number. All lenses of the same F number have the same "speed" no matter how much difference there may be in their individual focal lengths. That is because they all produce a light cone of the same shape. Of course, the longer type of lens with its correspondingly larger opening actually collects more light from each point in the object, but it also produces a larger "point" on the film, which exactly offsets the increased light.

In the early days of photography, lens makers soon discovered that no matter how they made the curves on a single lens, it was physically impossible to good results with a large stop opening. Then they found that much better results could be obtained by combining two lenses, each made of a different kind of glass so that the errors of one would partly offset the errors of the other. Simple lenses of this "doublet" type still are used on cameras selling at a dollar or two.

The next development was the "rapid rectilinear" consisting of a combination of two doublets. This was a big advance. The simple doublet could not be used with a stop bigger than F/11, whereas the rapid rectilinear allowed the larger opening of F 8 with reasonably good definition over most of the film area. Such lenses are still used on the cheaper grade of cameras selling at from $5 to $8.

THE next great advance was made possible by German scientists who discovered new forms of glass which bent or refracted rays of light in a different way from any forms of glass previously known. Working with these new types of glass, optical scientists were able to develop the modern anastigmatic lenses which give marvelously perfect images even with large stops.

Fig. 1 shows the scene in Fig. 2 when photographed with a high-grade anastigmat lens.

The term "anastigmat" means not astigmatic. In other words, the anastigmat lens sharply focuses both horizontal and vertical lines all over the picture area. Older types of lens are not able to do this, and the error is particularly noticeable near the margin of the picture.

Do not get the idea that you can go out and buy yourself a high-grade, fast anastigmat lens and thereafter take nothing but good pictures. The lens is after all only one of the tools of picture making. It makes good pictures possible, but it does not make them automatically. You must learn how to use the lens.

FOR example, the fast anastigmat with a large opening will permit a picture under light conditions that would render a slower lens useless, but in all lenses, the larger the stop you use, the less will be the depth of field. Refer again to Fig. 3 and it is easy to see that when you have a big opening in the lens, the cone of light is formed at a much steeper angle. Moving the lens nearer or farther away from the film will therefore throw points out of focus more quickly. This effect would be the same if you moved the object, and consequently the larger the stop the more fuzzy will every object appear that is nearer or farther away than the plane of focus.

Suppose you are taking a picture of a group of people and some of them are nearer the camera than the rest. Obviously if you focus with a large stop on the nearest person, the others will be out of focus; or if you focus on the most distant member of the group, the nearer ones will have a fuzzy appearance.

A smaller stop increases the depth of focus and makes objects nearer or farther away appear sharper.

This series of articles, which began in the June, 1931, issue, will be continued next month.

$10 *for the best* Photograph Showing ROOM INTERIOR

For the most photographically perfect picture showing the interior of a room submitted on or before June 1, 1932, POPULAR SCIENCE MONTHLY will pay $10. The only condition is that it must be taken during the months of April and May 1932, by an amateur. Any type of camera may be used, and the developing and printing may be done by a professional. Mail both print and negative to the Photographic Editor not later than June 1 and mark your entry "May Photo Contest." You may enter several photos, but if you wish them returned, please send a self-addressed, stamped envelope.

Winner of Eighth Contest

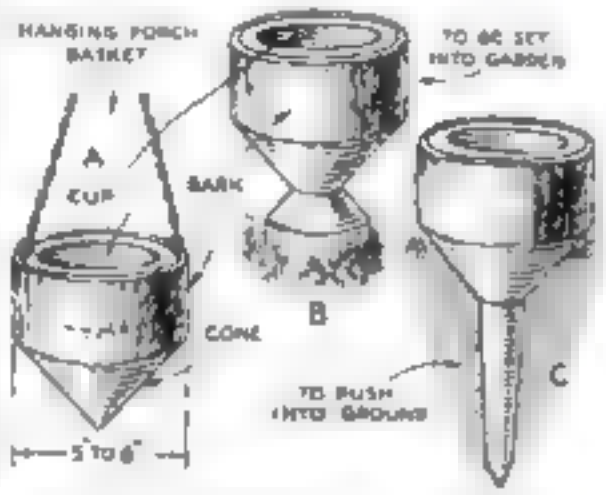
Anne W. Boyd, Ashton, Ill., has been awarded the $10 prize for the best picture in the photographic contest announced in the eighth article in the series (P. S. M., Jan. '32, p. 79). Those entrants winning honorable mention are as follows: Fred C. Bowditch, Jr., Brookline, Mass., Edward Brier, Honolulu, T. H., William Finch, Minneapolis, Minn., Alexander G. Grant, Jr., Southboro, Mass., Fred Wm. Pickell, Saginaw E. S., Mich., J. M. Stolan, Garfield, N. J.; Lloyd Thompson, Lawrence, Kans., Frederick C. Triquart, New York, N. Y., Mrs. L. W. Watts, Newton Centre, Mass., Clarence E. Weipland, Somerville, N. J., Frank Wilding, Cheltenham Pa., C. W. Woodall, St. Paul, Minn. The February winner will be announced next month.

PLANT HOLDERS TURNED FROM LOGS

RUSTIC plant holders for use on the porch or in the garden can be made at practically no cost for materials. Ash elm, hickory, or other native woods may be used and as the log is turned in the lathe while green, the work proceeds rapidly As far as possible, of course, the bark is left undisturbed The diameters of the pieces should range from 5 to 8 in. as a rule

At *A* in the drawing is shown a hanging porch "basket." This is turned with a recess or cup in the top about 3 in deep, and it has a conical base. While the block should be well centered for balance all unevenness of the surface and any variation from a true cylinder will only enhance the attractiveness of the finished piece. Note that sufficient stock is left in the middle of the cup to support the work on the tail center as shown in one of the photographs. This projection is later broken off at the bottom; whatever extra stock has been left at the live center is cut away

Before taking the block out of the lathe, smooth the turned surfaces with sandpaper and rub in a liquid wood filler, applying enough pressure to cause heat. When the filler is dry apply two coats of clear lacquer or varnish over both the turned portions and the bark Set two screw eyes into the edge and fasten to them a 30-in length of brass chain.



Three types of holders, one intended to be hung, the others to be set out in the garden

How the cup is turned. The stock left as a support for the tail center is later removed

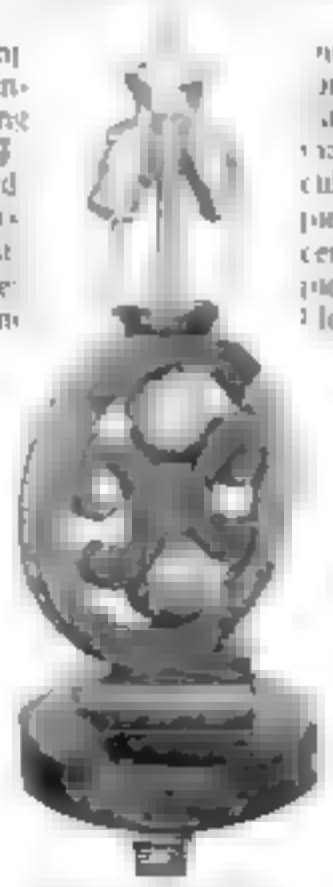
A variation of this idea is shown at *B* This holder is intended to be set out in the garden. Earth may be packed into the depression and seeds planted, or a potted plant can be placed in the receptacle. At *C* is a third type with a tapered spindle extending 6 or 7 in. so that the point can be pushed into the ground.—D. V. H

Hanging rustic plant holder for porch use

INLAID WALNUT RING IS NOVEL LAMP STAND

THIS modern looking table lamp combines wood turning and inlaying in a novel way. The ring is made of four segments of ¾ in. thick walnut or other hard wood glued with splined joints It is glued to a piece of waste stock with paper between the centered on a large faceplate and turned to an outside diameter of 9 in and a rim width of 1 in. A groove ¼ in wide is cut into the outside edge deep enough to receive a stock inlay banding which is glued in place and held with small C-clamps. When the glue is dry, the ring is smoothed with No. 00 sandpaper. It is then split away from the waste stock rechucked in the lathe and sanded on the opposite face

The round base is turned from a piece of 1¾ in stock to a diameter of 8 in., and a 7/16-in. hole is bored in the center to take a ⅜-in. pipe, which runs through the entire lamp. The sub-base is 5 in. square and beveled inward at the bottom. The groove for the inlay in this part may be cut on a router made with a dado head on the circular saw or chiseled by hand. This piece of course, is also bored. The central spindle is made from a piece ⅞ in. square to which blocks are glued at both ends to allow the two 2½ in. diameter balls to be turned. The cap on top of the ring is ⅞ in. thick and 2½ in. in diameter



Turned table lamp set off with inlaid bands

After the main parts of the lamp have been assembled, two scrolls are made and fitted within the ring as shown, and three inlaid feet are added. Several coats of shellac rubbed with fine steel wool are used in finishing, and the final coat is rubbed with rottenstone and oil.

This design does not need to be copied exactly, you will find it more interesting, indeed, to work out variations of your own.—JOHN M. CHITTENDEN

Flying Wing Airplane Model

Driven by TANDEM MOTOR

THIS unusual tandem-motored airplane model, which has a wing span of 36 in., resembles in some respects the recently developed "flying wing." With its out-rigger construction, its broad wing, and its pusher and tractor propellers, it embodies new ideas in design with which model makers will enjoy experimenting.

The model was designed and constructed by N. S. Cutler, of Mill City, Ore., who reports having made an unofficial time record of six minutes with it. The accompanying drawings, if studied in conjunction with the list of materials, will make clear the construction. The wings, outrigger, and tail are of balsa except the rudder outlines and the center splices of the wing, which are of bamboo. The wings are covered on both sides with Japanese silk tissue; the tail is covered on the lower surface, and the rudder on one side only. Two coats of model airplane dope are applied on the wings, and one coat is used on the rudder and stabilizer units.

The motor stick carries a rubber motor above as well as below. It is attached to the underside of the wings by means of two wire clips made as shown. All bearings, hooks, and cans are bound on with silk thread and cemented. Since tandem propellers are used, one must be right- and the other left-hand.

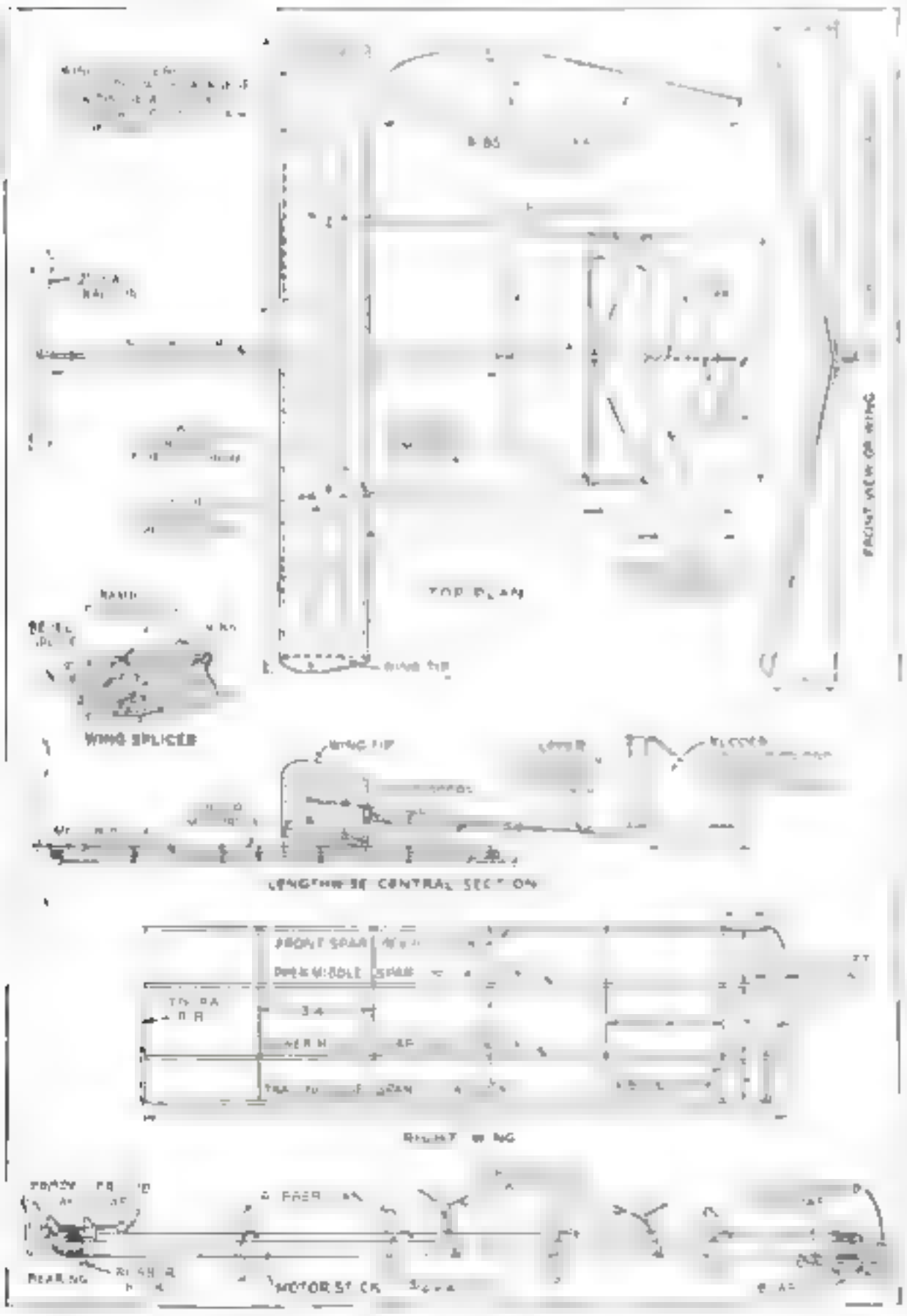
List of materials for

TANDEM MODEL

No. Pcs.	Material	T.	W.	L.	For
4	hard balsa	1/8	3/8	16	outriggers
1	" "	3/8	1 1/8	12	front prop
1	soft "	1/8	1 1/8	12	rear prop
1	hard "	49/64	3/8	45	motor stick
2	" "	3/32	1/8	14	tail spars
1	" "	3/32	1/4	8	" spar
1	bamboo	1/32	1/32	16	rudder
2	hard balsa	1/4	1/8	17 3/4	front spars
2	soft "	1/16	1/8	17 3/4	rear "
2	"			17 3/4	lower middle spars
2	" "	3/32	1/4	17 3/4	upper middle spars
1	hard "	1/32	1	36	ribs and tips
2	bamboo	1/32	1/8	1 1/2	wing splices

Also, 2 bobbed hairpins for propeller hangers, 2 small brass washers, 5 ft. of No. 8 music wire for cans, shafts, hooks, and clips; 2 sheets of Japanese silk tissue; 3 oz. of wing dope, and ambroid type cement.

Note: All dimensions are given in inches.



As these drawings make plain, the individual units of which the plane consists are of conventional construction, but the method of using tandem motors and outriggers is a novelty

The unusual arrangement of motor stick and propellers is shown clearly in this photograph

HOLDING BACK CURTAINS

THE simplest way to keep colored drawback curtains in place is by making use of small thumbtacks with celluloid covered heads. These are inexpensive and can be obtained in a large variety of colors in department stores and even in well-stocked [illegible] stores. W. C. R.

TROUT RAISED BY HAND

(Continued from page 51)

Lakes region is the carp and buffalofish center. After being taken from the lake waters, where they live in the mud and ooze of the bottom, they are kept for a time in clean water and fed whole shelled corn.

Railroad tank cars equipped with air pumps operating from the axle provide, for the marketable fish, deluxe transportation to New York, St. Louis, and other centers equipped for the handling of live fish. Often they are kept alive in tanks at the retail dealer's until sold to the consumer.

If you do not care to go into fish farming in a big way, you can create a "fish garden." In fact, the familiar goldfish bowl or aquarium is, in many respects, a miniature fish farm. In an aquarium you can raise fish and, within limits, realize a small profit from the production of fancy varieties.

The United States Bureau of Fisheries, while willing to give advice to anyone entering the fish-farming business, does not promise big financial rewards. A large initial investment usually is essential for a fair sized farm, and the upkeep often is high. In addition it takes a fish authority successfully to operate a farm.

THEN, after a fish farm is established and running merrily, one of the numerous fish diseases nearly wipe out the stock.

The fish farmer often starts on a small scale. He wants fresh fish for his own table, and proceeds to make arrangements for their production in a stream or pond that he owns. Later, as he becomes more familiar with the work, he may branch out to full-fledged farming. This, the Bureau of Fisheries claims, is the logical way to start.

Clarence R. Lucas, of the United States Bureau of Fisheries, in a survey of the fish farming industry, found that there were nearly 160 establishments producing trout and pondfish on a commercial basis in 1931. In 1929, employees at such farms earned about $186,000 in salaries. There were 231,141,721 trout eggs produced, 32,258,742 fry, mainly brook and rainbow trout, and 9,475,467 adult fish. Trout farm products sold in 1929 were valued at $1,072,700, while the pondfish business amounted to $714,197.

To the angler, there is a specialized form of fish farming having a wide appeal. This is the care, and perhaps the raising, of minnows for bait.

MINNOWS seldom are raised artificially because it is easier to catch them in natural waters than to propagate them. However, some forms, notably the blackhead and golden shiner, can be raised in ponds without difficulty.

For the benefit of fishermen the Bureau of Fisheries has formulated a number of suggestions on how to keep a captive minnow alive. A tank, pool, or aquarium should not be overcrowded, and a generous supply of cool, well-aerated water should be provided. A fine jet of air from a compressor or tank can be forced through the water if equipment is available. For feeding, ground meat, sour milk, or small insects are best, and should not be given in too large quantities or the water will become poisoned. A floating live box with a large screen surface provides another suitable means of keeping live bait.

Up to 1930, the fish farmer had little to worry about in connection with the marketing of his product. The demand for live and dead fish and eggs was greater than the supply, so that the farmer's only problem was to get his crops to a marketable stage. No one knows how long such a condition will continue; but even if it lasts forever the raising of fish will still be a game for the expert, a game whose success is doubtful.

MYSTERY OF LOST AMERICAN EMPIRE

Continued from page 17

convinced the Mayas that the stars in their courses were against them and their gods had deserted them. As calamity after calamity overwhelmed them, they felt helpless in the face of irresistible powers, and gave up in despair.

Dr. Cooke's discovery that natural forces caused the tragic dissolution of the Mayas has done more than solve this single problem. Scientists believe his conclusions open new vistas to investigators who are seeking an explanation of the equally mysterious disappearance of a number of other great historic peoples.

What, for example, befell the Accadians who, about 6,000 B.C., reared the first city on the ancient site of Babylon? What happened to the mighty Chaldeans who followed them? What caused the downfall of the inhabitants of Crete who, long before the days of the Greeks, established a flourishing civilization on their amazing Mediterranean island? What was the ultimate fate of the Egyptians, most advanced and powerful people of antiquity?

These questions never have been answered satisfactorily. Future study may show that these nations, like the Mayas, fell victim to the fury of blind natural forces such as floods, earthquakes, soil erosion, sand storms, or drastic climatic change.

DR. COOKE'S work was undertaken as part of a concerted effort by a group of scientific organizations to reconstruct the history of the Mayas whose rise, development, and collapse have been a constant challenge to science. These bodies are cooperating with the Carnegie Institution which for fifteen years has been excavating and restoring Mayan temples and palaces in the jungles of Guatemala and Yucatan.

Medical men, weather experts, specialists in tropical plant and animal life, anthropologists who can make precise measurements of the Mayas' modern descendants, psychologists, geographers, geologists, and even aviators are assisting the Carnegie Institution in locating and interpreting valuable finds. Recently, Captain Lewis Yancey, famous transatlantic flyer, made a successful landing in an autogiro on a terrace of the ruins of Chichen Itza, in Yucatan. Dr. Sylvanus G. Morley, director of excavations for the Carnegie Institution in that section, stated the use of airplanes will greatly facilitate the work by shortening the round trip from the base of operations, now made by truck and wagon, from six to less than two hours.

TO SHED light on the physical characteristics of the ancient Mayas, experts of Harvard University and the Carnegie Institution have measured 1,500 living Indians in Yucatan. Dr. F. M. Gage, of the University of Michigan, has begun to investigate animals and plants, hoping to learn more about the food of the ancient Mayas, and the materials they employed in making their useful articles and works of art.

Dr. G. C. Shattuck, of Harvard, heads a group of specialists who have spent the last two seasons studying health problems that may have affected the Mayas, while scientists from the University of Chicago are making a study of the Mayan language and its various dialects.

As a result of these and previous researches, many amazing facts about the Mayas have been brought to light. In their accomplishments, these earliest known Americans strangely anticipated several features of modern life. They erected forerunners of the present-day skyscraper, which they adorned with elaborate carvings in wood and stone. They originated the now popular setback design for tall buildings. They knew the uses of concrete and stucco, which they cast into ornamental forms. They discovered the principle of perspective, and applied it both in architecture and in painting.

Their farmers domesticated corn, white and sweet potatoes, lima and kidney beans, cocoa, cotton, tobacco, and many other cereals and vegetables which they raised in profusion on their hillsides. They discovered the medical properties of quinine, cocaine, and cascara sagrada. They were the first planters of rubber and the discoverers of chicle, the basis of chewing gum. They also were the first American sportsmen. They played tennis and squash, and the courts they constructed for these sports still are in good condition.

It was as astronomers and mathematicians that they excelled all of their Old World contemporaries. Their profound knowledge of these sciences, at which experts never cease to marvel, enabled them to create a calendar that stood without an error for nearly 3,000 years, that is to say, from a date corresponding to October 14, 3373 B.C., which they considered the beginning of the world, until A.D. 1561, when fanatical Spaniards destroyed most of the chronicles of the old Mayan Empire.

ACCORDING to Dr. Spinden, the Mayan calendar could have been used for 300,000 years before accumulating an error of a single day. Our present calendar will run only 3,400 years before it will develop one day's error. They invented the five-day week and the thirteen-month year, and used both more than 2,000 years ago. They conceived the idea of zero 1,000 years before the Hindus, who, in turn, passed it on to the Arabs and, through them, to our European ancestors.

Bit by bit patient investigation has pieced together much of the thrilling story of the Mayas. To this absorbing drama, Dr. Cooke's discoveries furnish the hitherto unknown climax. But the first act is still missing. Whence did the Mayas come? Where and how did they live before August 6, 613 B.C., when they carved their oldest known date upon a stone slab in Guatemala?

The extensive researches now under way in Central America may supply the opening chapter in the fascinating epic of Amer[illegible]

TIGER DINED ON HORSE 35,000,000 YEARS AGO

RECENTLY a scientific [illegible] was searching for tiny [illegible] the horse family, and other ancient inhabitants of the West, in the famous "Badlands" of Northwestern Nebraska. One of the party was slowly excavating the skeleton of an ancient saber-toothed tiger from the rock in which it was embedded. In the region of its digestive tract he found a mass of partially digested food. Examining this, he discovered a set of front teeth, still embedded in a bit of jawbone, of a tiny three-toed horse!

In other words, that prehistoric saber-toothed tiger had dined on an ancient three-toed horse. This happened in Tertiary times, nearly thirty-five million years ago! Fossil bone fragments are found occasionally in prehistoric stomachs, but it is unusual to be able to tell what an animal ate for dinner thirty-odd million years ago! This specimen is on exhibition in the regional museum of natural history at Agate, Nebr.

DEMAND FOR SILVER STARTS NEW RUSH

(Continued from page 21)

and complicated processes of modern industry in the separation of the "moon metal" from lead, zinc, copper, or gold, with which it is almost always found closely associated. There are a few "pure silver" mines, but for more than sixty years, the main supply has come as a by-product to one of the metals mentioned.

The most abundant of the many combinations of silver with other metals and acids is silver sulphide, known as "silver glance," common in the mines of Europe and Mexico. The second most abundant is silver chloride, called "horn silver," lighter gray than sulphide and lacking its metallic appearance. Silver also is found with arsenic, antimony, bromine, chlorine, sulphur, and, in smaller quantities, as the salts of various acids that have acted in the natural state on the white element. The form found with lead usually is sulphide of silver, and the ore is known as "galena."

IN THE old days of silver mining in America, the Indian slave of the Spaniard "gophered" on hands and knees in a shallow tunnel and shoved the broken ore behind him, to be gathered up in deerskins by others and carried up a notched tree-trunk to the surface. Today, the miner rides a car hauled by an electric engine along the tunnel to his particular "heading," and there uses a compressed air drill to cut holes in the vein. In these holes he places an explosive, and brings down at one blast more ore than his Indian predecessor would have chopped out in a week. The ore comes out in cars, hauled by a hoisting cable or by an electric locomotive, and is treated for the removal of the silver by one or more of several processes.

The old method of crushing and refining ores at the mine maintains only at the large deposits. The track-laying truck, towing two or three trailers filled with ore, has superseded the mule train for the transportation of the "rock" from mine to the nearest point on the railroad. There, the ore is dumped into gondolas and whirled away to the smelters.

At the "mill," the ore is first crushed in the stamps by automatic hammers. The hammers in these stamps are a foot or so in diameter and two or three feet long, weighing from 600 to 1,200 pounds. Fitted with replaceable shoes at the lower end, they are lifted and dropped by cams keyed onto the lifting rods about three quarters up on the stamps. As each hammer is lifted, it is turned part of a circle on its own axis, so that the shoes get even wear. Usually the height of the lift is about fifteen inches, and the stamps strike fifty to one hundred blows each minute of operation. Stamps similar to these were in use in Rome 2,000 years ago, and the main improvement in them is the application of electric, Diesel, or steam power.

WHERE there is much free silver or gold in an ore, mercury and water are added to the finely crushed rock, the whole forming a dense mixture called "slime." This slime is passed over copper plates covered with quicksilver, which picks out the gold and silver forming what is known as "amalgam." Mercury, vaporizing at a lower temperature than silver or gold, is eliminated by heat, leaving the precious metals behind. This is known as the "amalgamation" process. A similar method, known as the *patio*, has been in use in the silver mines of Mexico and South America since the sixteenth century. The *patio* process was devised, according to the best records *(Continued on page 118)*

DEMAND FOR SILVER STARTS RUSH

Continued from page 117

obtainable, by the Mexican, Bartolome Medina, a native of Pachuca, about the middle of the sixteenth century.

So crude was the early amalgamation process in Chile, one of the greatest silver-producing countries in the world, that the residue of the "slime" was molded into bricks and huts for the native miners built from them. When American mining engineers entered this field, they found that these supposedly worthless bricks carried from fifty to seventy ounces of silver to the ton. Hundreds of the mud huts were pulled down and their bricks forced to yield their hoarded silver by new processes. One of these methods is to roast the sulphide ores of silver with common salt, whereupon the silver is converted into a chloride, which is treated in tanks with a ten-percent salt-brine solution, quicksilver added, and the silver removed from the resulting amalgam by heat.

Sometimes, silver is found in the pure form, the two largest lumps ever unearthed being one of 750 pounds and another of 560 pounds, both in the Kongsberg district in southern Norway. The smaller of these two is still on exhibition in a museum in Copenhagen.

SILVER never has been found in any quantity west of the Sierra Nevada. Western Montana, Idaho, Nevada, Utah, Colorado, eastern California to a small extent, New Mexico, and Arizona are the silver-producing states. In the modern American mines, the amalgamation process has been so highly developed that 100 percent of the silver is extracted from the crushed rock in four hours. In a limestone cavern, near Eureka, Nev., was found a granular mass of "silver quartz" ninety feet long, forty-five feet wide, and twenty-five feet thick, assaying $25 to $175 a ton, almost solid carbonate of lead and silver.

Lixiviation leaching, is another and cheaper method of extracting silver from ore. One of the phases of this process is the "cyanide treatment," well known in the reduction of gold ores. In the lixiviation method the silver ore, with salt, is roasted in high-draft furnaces. The resultant chlorides of silver are treated with a number of chemical solutions of complicated composition, which precipitate the silver. In another form of the same process, the silver is converted into a sulphate, which is washed out and then reduced to pure silver. It is claimed that the lixiviation process saves a higher percentage of the silver in ores than does amalgamation, and that also, since it uses no quicksilver, it is less harmful to the men employed.

SINCE much of the crude silver produced in the United States contains varying amounts of copper, gold, lead, zinc, and other metals, some ores may be reduced by electrolytic processes, but their use is limited, due to the variability of the ores and to expense of electric current.

In 1876 a group of workmen found silver, both in the chloride form and mixed with lead, on Broken Hill, a mountain in the Barrier Range, New South Wales. These men, pooling their capital, sank a shaft, but unfortunately entered the lead deposit. Shares in their company sank faster than their shaft and in 1884 could have been bought for a few cents. About this time, another group of men, with a little more capital, found chloride of silver in a deposit of kaolin (clay) on the same mountain. From forty-five tons of clay, they took somewhat more than a ton of pure silver. From 1885 to 1952, this Broken Hill Mine produced more than $250,000,000 worth of silver from a vein 200 feet wide, several miles long, and not more than 800 feet below the surface. The original company shares, which sold for a few cents, have received approximately $50,000,000 in dividends!

Where silver is found with lead, as in this Broken Hill deposit, refining consists in concentrating the silver in not more than fifteen percent of the lead. Blast furnaces, charged with the ore, fuel, and limestone, are run off and the "pigs" of mixed lead and silver are treated with zinc, by which the silver is separated out and the lead saved. In many instances, the silver is finally concentrated in less than six percent of the lead.

As a final step, the lead, which has a much lower vaporizing point than silver, is melted and oxidized off by a blast of air blown over the pot of metal. Thus, the silver is left in hot, but solid, form after virtually all the lead is removed. This is known as "cupellation," and, in miniature, is the method used by assayers in determining the quantity of silver in a specimen of ore. It is known to have been used by silver miners in 600 B.C., and probably was devised centuries earlier.

THE cyanide process, mentioned above, consists in placing the finely ground ores of silver in tar-lined, steel vats, where the rock is thoroughly washed with caustic soda or some other alkaline solution to remove dirt. After this has drained off a solution of about one half of one percent cyanide of potassium is poured into the tank and allowed to remain for twelve hours, sometimes longer, depending on the character of the ore.

The cyanide solution is then run off and the vat left to drain for four to six hours. A water-wash, with a weak admixture of cyanide, is again run through the ore and both solutions, which have picked out the silver (or gold) from the ore, are passed over shallow boxes containing loose zinc shavings. The silver leaves the cyanide and deposits itself on the zinc.

By still another method, the cyanide solution is flowed in among thin lead plates, and a mild electric current passed through. The silver is then deposited on the lead. The silver is parted in roasting furnaces, where the lead is melted out.

The most important modern discovery in silver production, however, seems to be the roasting furnace. In this process, the ore is crushed dry, mixed with common salt, and dropped through an upward-blown flame, coming out in the form of silver oxide and chloride. So perfectly have these furnaces been developed that complete oxidation and chloridization may be effected in one passage of the ore through the flame. This method of treatment has resulted in the rescue of millions of dollars worth of silver from the "hard" ores of the western United States. After the roasting, the resultant chlorides and oxides are given the amalgamation treatment.

IN THE early days of silver mining, even in the New World, only fifteen to forty-five percent of the silver in ore was saved. Today, the saving is ninety-nine to one hundred percent. The cost of production of an ounce of silver varies from thirty-two cents in Mexico and South America, where labor is cheap and ores "soft," to thirty-eight and thirty-nine cents in Idaho where labor is relatively expensive and the ores hard. There was a time, in Arabia, when silver was more valuable than gold, but in general gold has been from ten to twenty times as valuable.

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war, I saw a French Coudron biplane fitted with twin floats, each having a wheel inside. The wheels extended an inch or two below the floats so they touched ground first. This idea is simple and has been tried often. The two drawbacks are that the added friction of the wheel makes it almost impossible to get the ship off the water, and in ground landing, the pilot must come down dead accurately so as to touch on the little piece of wheel that projects. Otherwise he will tear out the bottoms of the floats.

Telescoping struts, pushed down hydraulically, are used on many modern ships. They have to be pumped up and down laboriously in the cockpit. Then, there is the danger that the pilot may neglect to put down the wheels when he takes off from water and comes down on land, or that he may forget to lift them when he starts from land and comes down on the water. Pilots who do this sort of thing qualify for the mythical "Dumb-bell Club." I have qualified. Some sort of landing equipment that will serve equally well in coming down on land or water is needed. Perhaps this invention will come about through finding an answer to the next, or fifth, problem.

V. *A Substitute for Wheels*

The other day, Capt. Frank Hawks streaked across Roosevelt Field, Long Island, at the finish of a 500-mile flight from Columbus, Ohio, made at an average speed of 231 miles an hour. He circled the field in his red-and-white monoplane and then sat down. The ship was still rolling at fifty miles an hour when the left tire blew out. The little racer veered, dragged one wing, and nearly crashed into a standing ship before Hawks regained control.

Tire trouble is only one of the reasons a substitute for wheels on planes is needed. You remember one of Lindbergh's most serious crack-ups was caused by a wheel falling off during a flight in Mexico.

More than this, wheels are too heavy and cause too much resistance. On one big bomber, which I once tested, we found that more than eleven percent of the total resistance was caused by the landing gear. We figured it out and found it took a 125-horsepower motor just to pull that landing gear through the air!

Skids, without wheels, have been tried, but they have so much resistance sliding along the ground that it is almost impossible to get up flying speed. Future long-distance ships may start from greased runways on skids, or may have wheels which drop away as soon as the machine gets in the air. During the war, we had one Sopwith "Pup" that was equipped with nothing but skids. We used to take off from wet grass, the skids sliding along over this slippery surface with little friction.

A FRENCH inventor tried to overcome the friction of skids by having a series of small rollers inside them. The scheme worked all right on perfectly level and dry ground. But as soon as the roller-skids struck mud they clogged and failed to function.

Endless treads have been suggested many times. I saw one experimental monoplane several years ago, fitted up with such a landing gear. The trouble was that as soon as the speed increased the friction and resistance of the gears and rollers became so great that the effect was like trying to take off with the brakes on.

However, if some inventor can find a method for cutting down this resistance sufficiently, endless tread landing gears would solve many problems. A combination of flying boat hulls or pontoons and such treads might give the land-and-water gear that engineers are looking for.

VI. *An Aircraft Motor Silencer*

Almost every day the newspapers report some new kind of silencer for airplane motors. They have appeared in a thousand varieties. So far all have fallen down on one of four important points. They are either: 1. Too large, increasing resistance in the air. 2. Too heavy. 3. They cause back-pressure, reducing the power of the engine. 4. They have parts that quickly burn out.

Motor muffler experiments carried on at the Napier plant, in England, showed that when the exhaust pipes were carried back until the gases had time to cool, the engine power was little affected. However, long exhaust pipes are heavy. Some device that will cool the hot gases rapidly, but does not have the weight handicap of the lengthy metal pipes, is required as a feature of the successful aircraft engine silencer.

VII. *A Device to Speed Up the Take-Off of a Flying Boat*

Flying boats require bigger engines than land planes, of the same size, to provide the reserve power necessary in getting off the water. The resistance of the water on the hull is much greater than that of wheels running along the ground. A method of speeding up the take-off, or of getting the boat up on its hydroplane "step" more quickly, would be an important advance.

Attempts to solve this problem have been made with corrugated air inlets to the hull bottom. A cross section of these inlets looked like a wavy line. The effect was that air was carried back under the hull, so it rode along on bubbles, thus reducing water friction. The drawback to the idea is that the corrugated construction of the inlet makes it more easily damaged than that of the ordinary boat.

Hydrovanes, suggesting Venetian blinds, with each of the thin planes tilted up so they lift as the boat gains speed, have been attached to hull bottoms to give added underwater lift. But since they carry tremendous loads at high speeds, even a floating chip may cause them to break and seaweed or even fish may easily clog them and turn them into brakes instead of aids to lift. The problem of lifting flying boats out of the water with a short run remains for some inventor to solve.

VIII. *An Airplane Windshield Wiper*

That sounds easy. Nine out of ten people will say: "All you have to do is put on an automobile windshield wiper." But the problem is not so simple. Automobile speeds in rain and snow rarely exceed forty miles an hour, an airplane often rips through bad weather at four times that speed. And at 160 miles an hour, the air pressure on the windshield is not four times as great. It is sixteen times as great. At 240 miles an hour, an everyday speed in the future, it is thirty-six times as great. It is with such pressures that the inventor of aerial windshield wipers has to deal.

On most cabin planes, the protecting glass forms a V, the point cutting the wind, sending it to either side. A wiper operating on either side of the V would move with the wind easily, but on the return stroke, it would have to push against tremendous pressure. The ordinary automobile wiper is too fragile for the work. When a special one, along similar lines, is made rugged and equipped with an (Continued on page 120)

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operating mechanism powerful enough, the weight becomes too great.

Several years ago, a designer installed a whirling glass disk in front of the pilot to insure clear vision in bad weather. The edge of the disk was notched so the wind kept it spinning at high speed, centrifugal force hurling raindrops and snowflakes away as soon as they came in contact with the glass, thus keeping it clear. After a few trials, the idea was abandoned. In the first place, the apparatus was heavy, and, in the second, it probably could not have stood up under the increasing pressures of higher speeds. Moreover, it set up an unearthly shriek that would have drowned out a fire siren when the plane flew faster than seventy miles an hour.

Some sort of windshield wiper is needed that is light and strong enough to stand the wind pressures at the terrific speeds of future air travel.

IX. *A Concentrated Beam Landing Light*

WHEN a pilot has to sit down in an emergency night landing, he often wishes he had wing lights that would throw a more powerful beam for the same battery weights, so he could examine spots or pick out objects in selecting a landing field, eliminating need for parachute flares. Present-day landing lights do not do this. A wanted improvement is a lightweight wing lamp controlled from the cockpit that will throw out a small but extremely powerful beam.

X. *An Accurate Gasoline Gage*

ONE of the most important questions in the air often is: "How much fuel is left in the tank?" Gasoline gages will tell you whether the tank is half full or a quarter-full, but they won't tell you whether you have two gallons or only one gallon left. And that difference may determine whether you make a forced landing or reach your destination. A gage accurate down to gallons would be a great aid to a pilot on a long flight.

A number of inventors have developed electrically operated gages, but they were complicated and frequently got out of order. The common "float type" gage is simplest. The objection is that in diving and climbing and rocking in bumpy air, the gasoline in the tank splashes about so much that such a gage gives you only a rough idea of the amount of fuel left.

XI. *A Stable Helicopter*

THOMAS A. EDISON, at one time, tried to invent a flying machine that would go straight up and come straight down. Thousands of other inventors, less well known, have tackled the same problem. None has had much success. It is the easiest thing in the world to get a helicopter off the ground, but maintaining balance in the air remains an unsolved problem.

Your motor, which turns your wings one way, naturally tries to turn the body the other way.

When there is one rotating unit, like a single huge propeller pulling upward, the gyroscopic or toplike effect of the whirling structure increases the difficulty of control. Then, when two or more sets of whirling wings are employed in an effort to overcome these defects, the complicated gears and bracings necessary are multiplied, increasing the weight and the hazard of mechanical breakdown.

In Cierva's autogiro, often confused with the helicopter, the pilot can land straight down, but he has to make a take-off run at the start, just as in an airplane. The reason the body of the autogiro does not turn in the opposite direction from the moving vanes is that the vanes are not attached to the motor but are free, turned by the air like the blades of a windmill.

Even then it was not until Cierva incorporated the idea of hinged vanes, held stiff by centrifugal force, in his design, to overcome gyroscopic force, that his autogiro was a success. When I was doing the early test flying on the "windmill plane" in England, he told me, one day, that this idea came to him in a Madrid theater. He had worked on the problem of getting rid of the gyroscopic effect for weeks and was ready to give up the autogiro idea as a failure. To forget his discouragement, he went to see a play. In the middle of the performance, the idea of hinging the vanes popped into his head and solved the problem.

NOT long after the war, I was asked to look over a weird "endless bucket" helicopter that had been built by a British mechanic. On the outside of a chain, moving over upper and lower wheels, were large flaps. They were attached so they opened on the side going down and closed on the side going up. The mechanism was ingeniously offset to counterbalance the "upward pull" expected from the paddles.

The fate of a previous experiment with aerial paddles should have warned the inventor. In the early days of aviation, a wealthy Englishman spent a fortune on a "paddle-wheel airship." His idea was to have the wheels, similar to those on Fulton's steamboat, encased in a movable shell which covered one half the paddles at a time. When this shell covered the upper half of the wheel, the paddles would be driving the airship forward, when it was swung around so it covered the bottom half of the wheels the paddles would still be turning in the same direction but would be driving the airship backward.

[illegible] scheme as well as the idea for the "endless bucket" helicopter, was doomed to failure for the simple reason that air is too thin for paddles to "grip" efficiently. However, a solution of the problem of vertical flight is a needed and important development of the future.

XII. *A Drift Indicator for Blind Flying*

WHEN flying in a side-wind, a plane is carried off its course just as a rowboat crossing a river, is carried downstream by the current. If a pilot is flying within sight of the ground, he can check up on this drift by comparing his position above the country below with his map. But when he is above the clouds or flying in fog, he can only guess how far he is being blown off the line of his course. A badly needed invention is an automatic drift indicator that does not depend for its accuracy upon sight of the ground.

Planes of the future, I believe, will not be radically different from advanced designs we know today. They may be tailless "flying wings," with frameworks of beryllium, or other light alloy, with engines housed within the wings driving "free-wheeling" propellers, with variable-area supporting surfaces and with landing gears equally adapted for coming down on ground or water.

Future advance in aircraft most likely will come about not through revolutionary new designs, but through the refinement and improvement of airplanes as we know them now. In this work, an important part will be played by inventors who solve problems such as the twelve pointed out in this article.

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such a basketry jar with clay, burned away the basket, and got the first real earthen pot. And the pattern of the basketwork, which was left on the jar, was the beginning of ornamental design on pottery.

MR. MOK: What gave him the idea?

DR. WISSLER: For many years, people had smeared clay inside such baskets and also in wooden and bark buckets, and let it harden, to make them more nearly watertight. This fellow's real discovery was that a good, hot fire would speed up and improve the process.

MR. MOK: Of course, at first all pottery was made by hand?

DR. WISSLER: Yes, and our Indians and the African natives still fashion it that way. Yet, the potter's wheel goes back thousands of years; it is one of the oldest machines in the world. Mural paintings in the tombs of the ancient Egyptian kings show potters at work with a potter's wheel, a plain wooden disk. This was first driven by hand, but later they improved it by adding a treadle, leaving the potter's hands free to shape his creations. I need not tell you that the Egyptians, the Chinese, and later the Greeks were past masters of the art. Today, the potter's wheel is set in motion by a driving wheel and a belt, but the principle remains the same.

MR. MOK: What did our early ancestors wear? What were the first clothes like?

DR. WISSLER: For a description of the first clothes, I must refer you to the story of Adam and Eve, but the Eskimos and the Chinese were the first tailors.

MR. MOK: The Eskimos and the Chinese?

DR. WISSLER: I will tell you more about that in a minute. The well-dressed man of the Stone Age in Europe wore an animal skin, thrown about his body as a robe. The next step was to fit the skins to the body and feet. The first coat was made out of two deerskins. The two skins were fastened together around the edges and worn tail side up, so that one covered the chest with the tail at the throat, and the other the back with the tail at the neck. The skins of the two pairs of hind legs, sewn together, made the sleeves. That crude fur garment was the original ancestor of your jacket.

MR. MOK: What did they do with the heads?

DR. WISSLER: They made shoes of them. The oldest moccasins, dug from the ancient peat bogs of Europe, were made from the skins of deer's heads, which are somewhat shoe-shaped to begin with.

MR. MOK: How about trousers?

DR. WISSLER: They came much later, at least in Europe, and slowly developed out of footwear, or rather, out of the skin leggings that were worn in cold weather. At first, people had only breechclothes. Of all primitive peoples, only the Eskimos, forced by the Arctic climate, made really fitted clothing. They had the first suits, consisting of coats and pants, cut out of skins with stone implements to fit the size and shape of the wearer. The plainsmen of northern Siberia later did the same thing. Later still, the Chinese learned the trick, only they used silk instead of furs. When weaving developed in Europe, cloth took the place of skins. However, even then clothes were not cut to fit the body. Instead, the piece of cloth was woven in the shape in which it was to be worn. Cut and fitted garments did not appear in Europe until the Middle Ages.

MR. MOK: When was weaving invented?

DR. WISSLER: In [illegible] (page 122)

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its simplest form, weaving is almost as old as mankind. Curiously enough, weaving can be traced back to the same origin as pottery.

MR. MOK: How is that possible?

DR. WISSLER: You see, the same finely plaited basketwork which gave our friend the first potter, the idea for his earthenware jar, also was responsible for weaving. All primitive peoples make string and thread by twisting vegetable fibers, wool, or hair. That was the beginning of spinning, and it was this string or thread they used in sewing their fur garments with their bone needles. Spindles made of round stones, like huge buttons with a stick through the center, have been dug up in various parts of the world. Now, cloth is nothing but a fine matting, made by plaiting threads. It was only natural that primitive people learned to plait—that is, weave—strings into cloth, just as they had learned to plait twigs. The primitive loom, which was simply a wooden frame, is as old as farming—about 20,000 years. A number of threads stretched on this frame formed the warp, and the cross thread, or woof, was worked in and out with the fingers and later with a stick, just as you made little mats out of strips of colored paper when you were a very small boy. Weavers of fine tapestries still use this laborious method.

MR. MOK: Who improved on it?

DR. WISSLER: Again those clever people, the ancient Egyptians. At least, their pictures show looms in which the alternate threads of the warp are held up by crossbars to allow the woof thread, carried by a shuttle—a small, boatshaped device to be sent across at one throw. The Greeks and the Romans had the same kind of loom, and it was changed little during the Middle Ages and even later. The flying shuttle, which is driven swiftly across by a pair of levers, is only a little more than a hundred years old, and still is the feature of the power looms in our great mills.

MR. MOK: The early farmers, brewers, and weavers you have told me about all lived in the New Stone Age. How long did that period last? When did people first begin to use metals?

DR. WISSLER: People used nothing but stone, bone, and wood for their weapons and implements until about 5,000 B.C. In other words, the New Stone Age ended approximately 7,000 years ago. It is strange to realize that only 210 generations have come and gone since then.

MR. MOK: That makes me feel as though I almost might be able to trace my Stone Age ancestors. What was the first metal used?

DR. WISSLER: For ornaments, gold. For tools and weapons, copper.

MR. MOK: I wonder how people learned to mine copper?

DR. WISSLER: They did not have to mine it. Huge quantities in pure, usable form were found on the shores of the Mediterranean Sea, on the island of Cyprus, south of Turkey in the Mediterranean; in several other places in the Old World, and also on this side of the Atlantic, especially near Lake Superior, in Mexico, and along the Arctic coast. The Eskimos used it in ancient times. Like nuggets of gold, copper in its metallic state can be worked cold.

MR. MOK: How did the New Stone Age people get the idea of using it?

DR. WISSLER: As I said last month, the New Stone Age was the first age of specialization. The men of that period began to fit special tools to *(Continued on page 123)*

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special jobs. Naturally, they always looked for better materials. Now copper, in pure form, does not look unlike stone. Its discoverers must have thought they had found a kind of malleable stone, which they could pound into tools. They worked in copper for about a thousand years. Then came the Bronze Age. They found that bronze, now called gun metal—an alloy of copper and about one ninth part tin—had two great advantages.

MR. MOK: What were they?

DR. WISSLER: It was considerably harder than copper, and it flowed much more easily in casting. People had learned to melt copper and cast it into stone molds. While doing this, they discovered that copper that was impure because it had some tin in it flowed much more readily and made harder weapons and implements. Through experience, they learned the right proportions. So then they deliberately began to hunt tin. At first, they found it in profusion around the northeastern shores of the Mediterranean. Later, they combed the then known world for it. The ancient Phoenicians sent their ships as far as Spain to get tin. The Romans went to England for it. Bronze, too, was used for a round thousand years. The Iron Age began about 3,000 B.C.

MR. MOK: How was iron discovered?

DR. WISSLER: It, too, did not need to be discovered. It fell from the sky.

MR. MOK: From the sky?

DR. WISSLER: Yes, for meteorites were the first source of iron. Of course, the supply of meteoric iron was not large but what there was of it was very fine. It resembles nickeled steel, and is comparable to it in hardness and flexibility. As for smelting iron from ore, that probably was discovered when there was a raging forest fire in a woods rich in ore. At least, that is the way it is explained in ancient Chinese manuscripts, and I think it is a good theory.

MR. MOK: Do you think the Chinese were the first to forge iron?

DR. WISSLER: Possibly. Some scientists believe that the Negro peoples of Africa were the first blacksmiths. There are two reasons for that theory. First, iron is found in such a pure state in certain parts of Africa that it can be forged on the anvil at once. The natives of the Sudan and the Congo still do this. Secondly, on early Egyptian monuments there are pictures of African natives bringing tribute to the king. Some of the objects they are laying at his feet are painted blue, the color the Egyptian artists used to depict iron.

MR. MOK: What were the first furnaces like?

DR. WISSLER: They simply were pits dug in the ground.

MR. MOK: Several times in our talk, you referred to the pictures of the ancient Egyptians. Could they write as well as paint?

DR. WISSLER: Certainly, they had a written language. But the origin and development of writing make a fascinating story in themselves. We will take that up next.

CIVILIZATION did not begin until writing was developed, and without it history would have been impossible. Who first thought of expressing his thoughts in readable signs? Who improved on this invention—perhaps the greatest ever made? What is picture writing and cuneiform writing? Who devised the alphabet? These and other interesting questions will be answered by Dr. Wissler in the June POPULAR SCIENCE MONTHLY, *on sale May 1.*

CRASHES PROVE DRIVERS RECKLESS

Continued from page 11)

than nine percent when it was raining. Out of a total of 860,000 accidents, both fatal and nonfatal, which were studied, 715,860 occurred in clear weather.

And most accidents happened in daylight. Only a little more than four percent occurred at dusk, and only thirty-five percent took place at night. However, the fact that insufficient illumination increases the hazard of night driving is shown by the statistics. While only thirty-nine percent of the accidents took place either at dusk or at night, they were responsible for forty-eight percent of the deaths.

The hour of the day when most crashes happen is between five and six o'clock in the afternoon, although fatal accidents occur most frequently during the following hour, between six and seven. From one o'clock in the afternoon until six in the evening, the number of accidents increases steadily, hour by hour. Between one and two, four percent of all accidents take place, between two and three, five percent, between three and four, six percent; between four and five, seven percent, and between five and six, eight per cent. The hour of the day when fewest accidents occur—only slightly more than one percent—is between six and seven in the morning.

TWENTY percent of all automobile fatalities result from Sunday accidents. Next, as a danger-day for motoring, comes Saturday, with Thursday third on the list. Then, in the order of the number of fatalities occurring on them, come: Monday, Friday, Wednesday, and, last of all, Tuesday, with the fewest crashes of any day in the week.

When a motorist starts on a ride, if he meets with an accident, the chances that it will occur before he gets out of the driveway are one to 200. The chances of it occurring on a railroad crossing are slightly greater, of it happening on a bridge, one to 100, of it taking place on a curve, one to twenty-five, on a state highway, one to five, and at a street crossing, one to two and a half. While most accidents take place at street intersections, the largest number of fatal crashes occur on state highways where speeds are greater.

What kind of drivers are most frequently in accidents: young or old, experienced or inexperienced, men or women? Figures compiled in the survey upset some popular beliefs. For instance, they show that more than ninety-one percent of all drivers involved in accidents which resulted in fatalities or injuries were experienced motorists with a year or more of practice at the wheel. A total of 1,177,860 out of 1,281,400 drivers figuring in accidents last year were in the experienced class. Only 18,200—barely one and a half percent of the total—were men and women with less than three months experience in handling automobiles at the time of the accident. Overconfidence is given as a major reason for the high percentage of experienced motorists figuring in mishaps.

OUT of the 1,281,400 drivers included in the above study, the investigators found that only 97,800, or about seven percent, were women. Ninety-two percent of all accidents involved men drivers. Another study, based upon 7,600,000 motorists licensed in states requiring such registration, showed that the men had a nonfatal accident for every twenty-two licensed drivers while the women had one for every eighty-nine; men had a fatal accident for every 726 licensed drivers and women one for every 3,558. However, this study did not take into consideration the average annual mileage and the traffic conditions encountered by the two groups.

So far as age is concerned, the most hazardous time for automobile driving is under twenty. The accident record of drivers under this age, last year, was thirty-nine percent worse than the average. The record of those between twenty and thirty was twenty-nine percent worse than the average; between thirty and forty, three percent better than the average; between forty and fifty, twenty-nine percent better; and beyond fifty, thirty-six percent better.

With passenger cars outnumbering other types of vehicles on the highways, it is natural that they should figure most frequently in accidents. Four out of five fatal crashes, last year, involved private passenger [illegible]. Taxis and motorbuses were each responsible for a little more than one percent of the deaths. Although trucks were involved in only ten percent of the accidents, they were responsible for fifteen percent of the fatalities.

A few simple changes in the design of passenger cars would do much to reduce the present high accident rate, in the opinion of Victor W. Kullick, statistician of the Division of Motor Vehicles in California. His findings, based upon an extensive investigation of accidents in California and twenty-two other states, have just been reported to the Society of Automotive Engineers.

When the left windshield cornerpost is more than five inches across, he says, the hazard of accident is increased because the driver's vision is interfered with. Similarly, when side and rear windows are too narrow, a clear view to the rear is cut off, increasing the danger of making left-hand turns. Low seats often make it impossible for the driver to see the right-hand side of the road, causing accidents.

Steering-wheel light switches are another dangerous feature of modern machines, according to his report. Frequently, the coat sleeve of a driver has caught on the switch lever at the top of the steering column, turning off the light and causing complete darkness just as a turn was being made. Many deaths in California, during the past year, are attributed to such accidents. By eliminating these dangerous features, the report indicates, the annual toll of motoring mishaps can be materially reduced.

CIGARETTES ARE NOW HUNDRED YEARS OLD

THIS year is the hundredth anniversary of the invention of the cigarette, according to a French investigator who recently traced the odd story of its origin. He attributes its devising to gunners besieging Acre, in Syria, in 1832. A consignment of tobacco for the soldiers arrived at the front, but the pipes sent with it were smashed. The ingenious soldiers pressed into service the little tubes of India paper ordinarily loaded with powder for priming charges, filled them with tobacco instead, and the first cigarettes were born.

SEA DEPTHS MAY HIDE UNKNOWN MONSTERS

UNEXPLORED depths of the sea may be found to contain huge living creatures new to science, predicts Dr. William Beebe, noted undersea explorer who has descended a quarter of a mile beneath the waves in a steel ball with portholes for windows. Last year in Bermuda waters, he says, "we saw dimly huge shapes that came floating up from the depths. No one has seen them before and I feel sure that work at deeper levels will reveal the presence of unknown monsters."

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TUBES FOR SPECIAL RADIO JOBS

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equivalent of the other tubes in the group.

Here too, the situation is the same as with the general purpose tubes, for you could operate the 224, 232, or 237 in a circuit designed for any one of them, provided you arranged for the proper heater current supply.

Note that the 224A tube is exactly like the regular 224 except that the 224A has a quick heater element. It gets into operation about ten seconds after the current is turned on. The 224 takes longer.

The latest thing in tubes designed for radio-frequency amplification is the 235 variable Mu tube which was announced nearly a year ago (P'S M June 31 p. 21). Development work has been going on, however, and at this writing it is believed that a new pentode type variable Mu tube will be manufactured next season.

THE type 245 will be exactly like the 247 except that it will have an added section which gives more power. This is when a powerful local station makes it necessary to turn the volume control to a low level.

The first power tube, the now obsolete type 112A, was developed from the 01A in an attempt to get a tube that would handle more electrical power and consequently give greater volume from the speaker without distortion. A still more powerful tube, the 171A, had taken its place even before the changeover to full electric operation. The 171A proved equally useful on alternating current and so was used until the advent of the type 245, a tube so powerful that two of them in the push-pull circuit will give all the volume the average home owner can stand.

Now we have the power pentode, type 247, which will handle a little more power than even the 245 and also give far greater amplification. Similar tubes (though of somewhat less power, are available for two and six volt circuits. They are types 233 and 238.

The remaining tube classification, rectifiers, started, in the heated filament type, with the 216B, which was later much improved and called the 280. This tube now serves to rectify the alternating current for the B supply in virtually every set sold.

What new types of tubes may we expect in the near future? Probably several forms of pentode screen grid tube with an extra screen between grid and plate, connected to the cathode. The function of this extra tube element in radio-frequency tubes will be similar to that in the power pentode type 247, and consequently will result in a great gain in radio-frequency amplification. Just what practical advantage this will be is not quite clear, since with the tubes we have we now can get more radio-frequency amplification than is practically useful. Perhaps the greater amplification will make possible the production of simpler and less expensive circuits.

EVEN a casual inspection will show that modern types of radio tubes are mechanically elaborate structures. Although the base and glasswork remain approximately the same, new elements and bracing for them should, logically, increase the cost as compared with older, simpler tubes. However, a vast amount of development in tube making machinery has resulted in better tubes at lower prices.

The only other new development in sight is a new form of rectifier tube to take the place of the 280. This new tube probably will be of the mercury vapor type and its chief advantage will be ability to handle heavier currents, with less loss in voltage.

KEEP YOUR HOUSE NEW

(Continued from page 67)

up by using roofers' cement—a soft, pliable material that can be worked into the crack to make the joint tight. Sometimes it is necessary to replace pieces of the metal. When nailing the new metal pieces to the roof, the depressions in the metal made by the nailing should be filled, as otherwise water will stand in them and cause rapid deterioration of the metal.

Metal is also used at the joints where two sections of a roof at different angles come together. This is called a valley. The metal pieces are inserted under the shingles at both sides and should be examined occasionally to see that they are sound.

As we have no way of determining when or where a loose joint, crack, or worn spot will become visible, it is in the interest of economy to keep the house fit by preserving the various materials as best we can. There are available today many products that, primarily preservatives, will give new life to the structure and also improve its appearance. Paint is a preservative of wood and a coat of paint every year or so actually will give new life to the wood. Everyone knows that a coat of paint will make old things look new.

THERE is a product that may be applied like paint to stucco walls which serves to preserve the stucco, make it more nearly weatherproof, and at the same time makes the stucco surfaces appear like new. This material is available in various colors, so you can change the color scheme to suit yourself. There are similar products for treating old floors and there is even a preservative for wall paper. After applying it, spots can be washed off without damaging the paper surface.

While we are on the subject of wall paper, it is well to remember that it is best not to hang new paper over old unless it is absolutely tight and free of cracks. In any case, never hang new paper over more than one layer of old. Before new paper is hung, be sure all plaster cracks are repaired. Even the smallest plaster crack should be closed. This is done by deepening the crack in the plaster back as far as the lath, so the new plaster can get a tight hold on the lath. The new plaster should be allowed to dry thoroughly before hanging the new paper.

Every precaution should be taken to prevent leaks in the water pipes. As it is difficult to get at these pipes, hidden in walls or floors, a great deal of damage may be done, if they develop a leak, before you discover that anything is wrong. So, when you see that the water does not have its natural pressure or that it has a rusty color, you may be sure the water pipes are getting clogged and that new ones had better be installed.

A FEW years ago, a leak in a water pipe was considered almost a calamity. It meant cutting holes in floors and walls, and the repair bill often ran into high figures. Most water pipes are made of either iron or brass and are rigid. Wherever a rigid pipe turns, to go around a beam or a corner, it is necessary to install what is called an "elbow joint." These are quite easily introduced when the house is being built, while floors and walls are still open, but when a leak occurs later on, it requires cutting in walls and floors to make the new connections.

There is now available a flexible copper tubing that may be pushed into the wall and which will bend itself around beams and corners. Generally the old pipe is allowed to remain and a small opening made in the wall through which the tubing is inserted. Connections to the present pipes are made outside the wall of the house by means of a special fitting that gives a tight joint between the old iron or brass pipe and the new copper tubing.

We must not think that our only gain in making repairs promptly is in the dollars we save on bills. Suppose you outgrow your old house or business changes make it necessary for you to move to another town, or for some other reason you wish to sell your house. In these days when modern houses have so many advantages over those built fifteen or even ten years ago, a prospective buyer looks your old house over carefully before making you an offer. The resale value of a house depends entirely upon how much consideration you gave to its upkeep. All manufacturing concerns set aside a certain amount of money for maintenance. In running your house this item should receive careful consideration. Also the condition of the house is very important when it comes time to renew a mortgage. Even in times of rigid economy, a moratorium on house repairing is no way to bring back prosperity.

MONEY to be spent on upkeep need not be spent all at one time. In fact it is much more satisfactory to spread it out over the whole year. For example, in the spring when the cold weather seems to have passed, take time to clean out the furnace thoroughly, look over the connections of the chimney, and remove the smoke pipe—the pipe that runs from the furnace to the chimney—and clean out the soot and stand it up in the cellar. This will materially lengthen the life of the pipe. Also make repairs to packing around heating pipes in the cellar. Much heat may be wasted by not giving this proper attention. In the spring do any painting to the outside that is necessary. Look over the screens and have them in good shape before it is time to put them up. It is well to put a drop of oil in the hinges of the screens before putting them up and when you take them down. This prevents rusting.

In the summer, make it a point to see that all windows are tight. It may be that some weather stripping needs to be replaced. The summer is a good time to look over the roof, check up on the valleys and the flashing and look for even small imperfections in the shingles. While the weather is warm, inspect the plumbing. Clean out the traps. The trap is a U-shaped pipe under each wash basin. It serves to keep foul odors from coming into the room through the pipes and acts as a sort of stopper or cork. It can be cleaned by removing the nut in the bottom or floor side of the U-shaped pipe. It is just as well to do this twice a year.

DO NOT neglect to stop even a small leak in the faucet, as it may waste a lot of water. The leak is due to a worn washer. First turn off the water in the cellar. Remove the octagonal nut on the top of the member into which the handle fits. This will allow you to lift the handle out of the faucet. At the end of this member is a screw that holds a washer in place. Replace this washer with a new one and insert the member and tighten the nut.

In the fall clean out the rain water gutters on the roof. During the summer leaves may have found their way into them, and if these are allowed to remain, ice, forming over the leaves, may clog the gutter.

Reserve the winter for making repairs to the inside of the house. Paint and plaster will dry quicker when heat is on. This is the season to hang new wall coverings, to freshen up old floors and lay new ones, and to apply various kinds of preservatives that give new life to the interior of your house.

NEW CONTROLS ADD THRILL TO MOTORING

(Continued from page 72)

important; the big thing is the sensation you get. There's a sort of airplane feel about it. The car just floats along when you take your foot off the throttle and you don't get that tied-down, dragging effect of the throttled motor."

"What's this 'wizard' control I hear about?" Barnly asked. "Do you have to be a magician to operate it?"

"No magic about it," Gus said. "I suppose they called it 'wizard' because it's easier to say than vacuum operated clutch throw-out interconnected with the throttle, which is what it is. It's another way of getting free wheeling and it has its advantages, too. Under the floor boards is a short, fat cylinder with an air-tight piston hooked to the clutch pedal. A hole in the opposite, closed end of the cylinder is piped to the intake manifold through a valve worked by a little pedal to the left of the clutch and also through another valve that is tied to the throttle pedal. It's set so that if your foot is resting on the pedal to the left of the clutch and you take your foot off the throttle, the vacuum of the manifold opens the clutch and you coast along just as you would if you'd pushed down the clutch pedal.

"WHEN you step on the gas again, that shuts off the manifold vacuum and the clutch automatically takes hold. It's simple enough, because if your left foot isn't pressing down the small pedal to the left of the clutch—and the spring is so light the weight of your foot does it—you get regular operation. With your foot resting on the pedal you get free wheeling."

"That sounds simple enough," Barnly cut in. "Now tell me what all this talk about silent shifting amounts to. I can shift gears now so you can't hear 'em. Why do I need any extra fancy business?"

"A lot of people I know do need it," Gus growled. "Still, I think you'd like a transmission of that kind because you don't have to watch your timing so carefully. There are several different arrangements. Cars that have an overrunning clutch to get the free wheeling, and most of 'em are that way, don't have to do so much to get silent shifting. When you take your foot off the gas pedal on a car like that, the overrunning clutch releases and the whole transmission slows down with the engine just as it would in an ordinary car when you slow down the whole car. It's no trouble to shift into second or even first from high in an ordinary car when it's just barely rolling along."

"HOW does an overrunning clutch make that possible?" Barnly asked. "I'm a bit hazy about how it works. Is it some new mechanical principle?"

"I should say not!" Gus replied. "Overrunning clutches of many different kinds have been used on machinery for years and years. An overrunning clutch is any type of clutch that works only one way—in other words, that holds two shafts only when the strain comes in one direction."

"Like a turnstile, eh?" Barnly observed. "Turns free one way but locks the minute you try to turn it the other."

"Well, I used to get a lot of fun out of twiddling the dials on my old radio set trying to get distant stations loud enough to hear 'em, so maybe I'd get some fun out of driving a new car once I found what all the controls were supposed to do."

"I think you will—most people do," Gus agreed. "After all, a man likes to feel that he's really running the car, and the controls help to make him feel that way."

How Medical Experts Find Murder Secrets

(Continued from page 38)

found. From an examination of a skull or pelvic bone, these skilled anatomists can tell whether they came from the skeleton of a man or woman. From the study of a single bone, they can sometimes determine the age and height of the unknown victim. And from no more than a small fragment or splinter, they can say whether it belonged to a man or animal.

This latter ability figured in one of the most fantastic crimes on record, the weird "Kangaroo Murder," recently reported from the gold fields of Australia. A young prospector set out for the interior and disappeared. He was traced in the company of a partner to a certain spot where a large fire had been built. Here the trail was lost. A little later, a murder story was published in England, written by a former West Australian. In the plot of the book, the body of a victim was disposed of by burning it with that of a large kangaroo, so a casual examination of the ashes would show they were those of an animal.

THE father of the missing prospector wrote to the author and learned that the idea for getting rid of the body had been suggested to the author by the very man who had been the partner of his missing son. Police obtained ashes from the fire where both men were known to have camped, and a scientific detective analyzed bits of bone. He found they were of both human and animal origin. The prospector's one-time partner was arrested and placed on trial for murder.

Teeth, as well as bones, often play a key part in the identification of victims and the tracking down of criminals. Not long ago, on the outskirts of Vienna, Austria, the body of a woman, charred beyond recognition, was found by the police. As a possible clue, detectives made a moulage cast of her teeth before the body was buried and placed it in the museum at headquarters. A few weeks later, a dentist, viewing the exhibits, recognized the teeth as those of one of his patients and sent the police off on the trail of the murderer.

The strangest case of crime detection through a clue supplied by teeth took place not long ago in Los Angeles, Calif. Before a dinner party at her home, a wealthy society woman locked $10,000 worth of jewelry in the till of her trunk, which also contained a pint of whiskey. Before the guests departed, she discovered the lid of the trunk had been pried open, the jewels taken and half the whiskey consumed. Police searched the guests without discovering the gems. They examined the trunk and whiskey bottle for fingerprints. There were no telltale marks. Then, it was noticed that the cork of the whiskey bottle bore teeth marks. The robber had evidently pulled out the cork with his teeth.

LIEUT. REX WELSH, scientific sleuth of the Los Angeles police force, was summoned. He examined the dents in the cork and then had the guests make "snap" impressions by biting into cakes of wax. At his laboratory, he cast the impressions in plaster of Paris. Three teeth of one of these white casts fitted perfectly into the depressions in the cork of the whiskey bottle, pinning the crime upon the guilty guest.

At the Scientific Crime Detection Laboratory, at Chicago, Dr. C. W. Muehlberger, toxicologist and medical expert of the organization, showed me how to make a quick test for blood. Over a suspicious brown stain on a coat, he placed a small piece of white filter paper. Then he poured together two chemicals, benzidine and hydrogen peroxide, and placed a few drops of the straw-colored mixture on the paper. Instantly, brilliant blue-green streaks radiated out in all directions from the center of the spot. This tiny, octopus-shaped green stain, I was told, is infallible proof of the presence of blood.

While some other substances react with a green coloration, none of them do so instantaneously. An eighteen-year-old blood spot, in one case, reacted instantaneously to the test. It is impossible, I was told, to remove stains by washing garments so they will not react to the chemicals.

In Germany, queer magnifying glasses that attach to ordinary spectacles by means of metal stilts have been introduced for the use of scientific sleuths in searching clothes for bloodstains. During such a search, the garments are placed on a tailor's dummy or hung by pins on a line so they can be examined inch by inch. At the famous Institute for Judicial Medicine, in Berlin, long rows of experts bend over microscopes examining the molecules in blood-samples to determine to which of the four types of human blood they belong.

NOT only can science group the blood of humans into four different types, but the saliva of the mouth can be divided into similar groups, recent experiments in Japan have indicated. The Oriental criminologist, Ichioku Haraguchi, reports he has been able to pick out the different blood types by examining the remains of saliva on cigarette stubs and toothpicks, some more than eight months old. This discovery puts into the hands of the scientific sleuth a new method of discovering clues to the identity of wanted men.

An unusual case in a western state, some years ago, gave another kind of problem to the scientific detective. The victim of a hold-up on a pitch-black night was seriously wounded. He told police he recognized his assailant as a former employee by the flash of the pistol shot. Lawyers for the defendant declared this was impossible. A scientific sleuth was called to answer the question: Can the human eye see enough in the flash of a revolver shot to recognize an assailant? Up to a distance of twenty-four feet, his tests showed, an assailant who is well-known to the person can be recognized if the person is facing him on the side of the line of fire. If the attacker is a stranger, such a fleeting glimpse of his features will be insufficient to obtain a clear idea of the details of features and clothing necessary for identification.

A PECULIAR thing noted by medical examiners in connection with the eyes of suicides came to the aid of detectives recently in an eastern city. It helped solve the "Four Leaf Clover Case," a carefully-planned and almost perfect crime.

Living alone on the top floor of an apartment house was a wealthy elderly man. His only relative was a young nephew. Shortly after nine o'clock one evening, tenants of the building heard the sound of a revolver shot in the old man's room and, a moment later, a frantic pounding on wood.

They found the nephew in the hall, hammering on the outside of the locked door of his uncle's apartment. He had come, he explained, to see his uncle and just as he reached the top of the stairs, he had heard the shot inside the apartment. Police broke down the door. All windows of the apartment were locked from the inside and the door key was found on the varnished floor two feet inside the room. The old man lay crumpled beside his chair. A revolver near by was easily recognized as his own by a curious four-leaf-clover design cut into the handle. A bullet had penetrated the brain through the right eye. The inference was clear that he had locked himself in the room and then committed suicide.

An axiom among scientific detectives is: "A suicide never shoots himself through the eye." Although it means instantaneous death, few people have nerve enough to look into the barrel of the gun. The detectives were suspicious. In the young man's pocket, they found a pair of light kid gloves and a folding rule. By means of quick chemical tests described in a previous article (P.S.M., Feb. '32, p. 34), they discovered that the pores of the leather of the right glove, between the thumb and first finger, contained deposits of gas which is driven back from the chamber of an exploding revolver. This scientific evidence that he had just fired a revolver exposed a remarkable plot.

THE young man confessed he was in financial difficulties at the bank where he worked. He had planned the death of his uncle, whose money he would inherit. Wearing gloves, to leave no fingerprints, he had committed the murder, using his uncle's revolver. As soon as the fatal shot was fired, he had stepped quickly into the hall, locked the apartment door from the outside, pushed the key under the crack with the long rule and then, before the other tenants of the building arrived, began to pound upon the locked door as a final act of his cold-blooded and calculating plot. His scheme probably would have succeeded but for the dramatic clues produced by science.

In other cases, the knowledge of the medical laboratory has upset alibis by proving a victim and a suspect ate the same food at the last meal. It has identified unknown criminals through hairs found on discarded clothing. It has showed, through study of the tissues of the lungs, that "drowning" victims were dead before they reached the water and that persons "burned to death" were not killed by flames.

By these, and other tests, medical examiners and scientific detectives are often able to expose the canniest deceptions of crafty killers and crooks.

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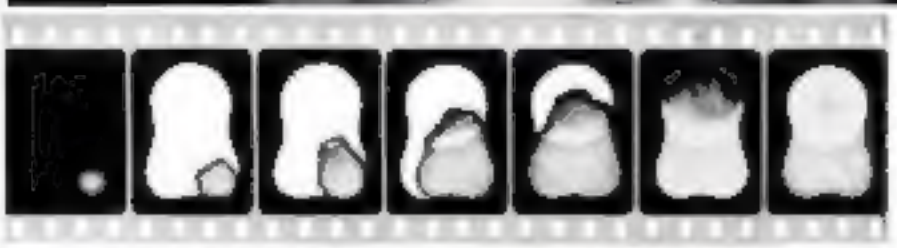
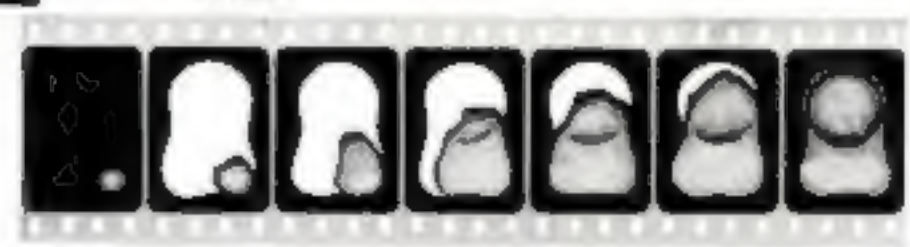


ORDINARY GASOLINE is in the cylinder. You see the spark in the picture at the left. In the next the gasoline vapor starts to burn. More—more—more burns. Then suddenly, in the ninth picture—BANG! The remaining unburned gasoline explodes. That is KNOCK. The last picture shows nothing but afterglow. Knock wasted the gasoline that should be working now.



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